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UNIVERSITY OF PITTSBURGH, PITTSBURGH, PA.

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THE VALUE OF INSTITUTIONAL MEMBERSHIP

C. C. WILLIAMS, President

Institutional Membership, like government, is one of those intangible values that flow from and are available only through cooperation. It should be sought and prized by every engineering college of recognized standing, for the benefits far exceed the cost to the participant.

Engineering teachers individually profit by membership in the Society because of the means provided through publications and conventions for an interchange of ideas and from the personal contacts afforded. An idea is much more valuable after having been exchanged. Engineering colleges are benefited through the development of the profession and the status of engineering, as well as in matters of effective and efficient administration of curricula. For example, the results of a $150,000 study of engineering education, a series of summer schools, and other perquisites accrued to engineering colleges without cost to them, through the offices of S. P. E. E. The Society, as the voice of engineering education, is in a position amongst professional societies to secure for engineering education the recognition that is its due. It conserves the heritage of engineering education and gives form to present endeavors. The Society is a joint enterprise between teachers as employees and institutions as employers for the advancement of engineering education. Both parties reap benefit from the operations of the Society and those benefits are in proportion to the strength and vigor of the organization.

The average number of members on one faculty is approximately 20, and they pay collectively to the Society $100 per year dues. The College pays 15 per cent of this sum for the counterpart institutional membership having a comparative value. In the absence of definite figures, we may suppose that the average annual budget of engineering colleges is $100,000. The dues for institutional membership amount to less than 0.02 per cent of that budget, and it is probably safe to say that the values derived, although mostly of an intangible character, frequently exceed those from the funds spent for equipment.

Each college of engineering may well feel an obligation, therefore, to pay its fair part in the creation of so great a group value. Like citizenship in ancient Rome, although easily acquired by those qualified, institutional membership is worth a great price, readily recognized by those institutions not now possessed of this asset.

SUMMARY OF CONFERENCES HELD AT THE FORTY-SECOND ANNUAL MEETING OF THE SOCIETY AT CORNELL UNIVERSITY, JUNE 19–23, 1934

There were 104 papers presented at the twenty-one conferences. It is impossible to publish all these papers. Each chairman was asked to prepare a brief summary of the work of his conference. We are giving herewith the reports received in this office as of September 28.

F. L. BISHOP, *Secretary.*

CHEMICAL ENGINEERING UNIT OPERATIONS TEACHING

Sessions of the conference on chemical engineering teaching, Professor F. C. Vilbrandt, Chairman, convened on Tuesday afternoon, June 19, Wednesday afternoon, June 20, and Thursday morning, June 21; joint sessions with the conference on Fluid Mechanics on Tuesday evening and with the conference on Heat Transfer on Wednesday morning were also held. Twenty-two chemical engineering teachers attended, representing the following institutions: Carnegie Institute of Technology, Case School of Applied Science, Columbia University, Cornell University, Drexel Institute, Georgia School of Technology, Iowa State University, Newark College of Engineering, Ohio State University, Pennsylvania State College, Pratt Institute, Princeton University, Purdue University, University of Detroit, University of Maine, University of Michigan, University of West Virginia, University of Wisconsin, and Yale University. Attendance at individual sessions averaged about eighteen.

The conference program was devoted primarily to various aspects of the following subjects: chemical engineering curricula, types, organization of, and methods of teaching chemical engineering courses, administration of chemical engineering, laboratory equipment and organization and administration of the chemical engineering laboratory, chemical engineering research, and industrial contacting and collaboration. The individual sessions were planned and arranged primarily as round table discussions of important aspects of these subjects rather than devoted entirely to formal papers. The few short papers scheduled for each session served as introductions to the round table discussions of the various

subjects. Prepared written discussions requested by the Chairman prior to the conference were presented in a number of cases.

Under the able leadership of the Chairman and those appointed as leaders of the discussion on the various scheduled topics, the above program was excellently carried through. A large percentage of those in attendance participated in the discussions, the comparatively small group greatly encouraging and facilitating active participation. It was the opinion of the group that a conference of this type is of great value to the progress of chemical engineering teaching as well as to the individual teacher.

The following papers were presented at the Tuesday afternoon session: "Resume of Chemical Engineering Education in Colleges and Universities" by F. C. Vilbrandt, "Contributions of Courses in Chemistry, Physics, Mathematics, Economics, English, and Other Engineering to Chemical Engineering Unit Operations Courses" by J. C. Elgin, and "Curricular Placement and Relationship of Chemical Engineering Courses to the Above Basic Courses" by J. H. James. The paper by Professor Vilbrandt outlined the present status of chemical engineering curricula, teaching, and facilities in various institutions, supplementing and bringing up to date previous reports by others on this subject. A round table discussion of these papers and of the critical evaluation of the basic courses to chemical engineering and the curricular location of chemical engineering courses followed. Professor Elgin served as leader of this discussion, and those participating were Badger, Coles, Elgin, Hodge, Stewart, Shreve, Mantell, and Vilbrandt. Among the specific questions considered were the relative importance of physics and physical chemistry to the unit operations course, length of the curriculum, value of a fifth year, and the importance, desired nature of, and method of teaching, courses in Economics, Modern Languages, General Chemistry and Qualitative Analysis, and Mathematics for chemical engineering students.

At the joint session with the conference on Fluid Mechanics held on Tuesday evening, J. H. Koffolt of the chemical engineering group presented a discussion of the "Chemical Engineering Applications of Fluid Mechanics."

At the joint session with the conference on Heat Transfer held on Wednesday morning W. L. Badger and O. A. Hougen of the chemical engineering group presented papers respectively on "Heat Transfer and the Phenomena of Evaporation" and "Heat Transfer and the Phenomena of Condensation of a Mixture of Condensable and Non-Condensable Gases." Professor Badger outlined briefly the subject of evaporation and the heat transfer factors involved and discussed the method utilized by him for the instruction of students in this field. Professor Hougen speaking

in place of A. P. Colburn pointed out the importance of mass transfer in determining heat transfer coefficients for mixtures of gas and vapor and the method of evaluating the various film and overall coefficients for this case for design purposes.

The Wednesday afternoon session was devoted largely to the subjects of teacher preparation and opportunities for advancement, lecture methods of teaching chemical engineering, and seminars and technical lectures in this field. Professors James, Hodge, and Molstad served as leaders of the round tables on these subjects, respectively. Professor Vilbrandt presented a discussion of teacher preparation for chemical engineering and methods by which the teacher may continue to advance in his field. Professor Shreve of Purdue University presented his method of teaching a course in the Chemical Unit Processes as compared with the Unit Operations and pointed out the advantages of this method of presenting industrial chemistry and chemical technology. This paper was of especial interest since methods and ideas involved are comparatively new and Professor Shreve has been one of their originators. "A Plan of Presentation of Course Matter in Industrial Chemistry Lectures" was presented by Professor Vilbrandt, and a written discussion of methods utilized for instruction in chemical engineering subjects at Yale by Professor Molstad. Round table discussions of these several topics were participated in by Badger, Bunger, Coles, Elgin, Hodge, James, Janness, Kintner, Koffolt, McKee, Molstad, Stewart, and Vilbrandt.

At the session on Thursday morning the subjects of chemical engineering laboratory equipment, the administration of laboratory work in chemical engineering, laboratory notebooks and texts, research possibilities for laboratories, and industrial contacting and collaboration were considered. The leaders of the discussions in these subjects were, respectively, Professors Koffolt, Vilbrandt and Hougen, Kintner, Vilbrandt, and Shreve. New chemical engineering laboratory equipment at the University of Louisville, Carnegie Institute of Technology, and Princeton University was described. Papers on "Squad Teaching" by H. A. Webber of Iowa State University, and "Demonstration Teaching in Laboratory Practice" by L. E. Stout, Washington University, were read by the Chairman in the absence of these authors. Professor Stratton's paper on "Coöperative Industrial Contacting" was read for him by a colleague, Professor Knapp of Drexel Institute. O. A. Hougen discussed the use of the comprehensive problem in chemical engineering teaching. "Chemical Engineering Laboratory Notebooks and Texts" by S. C. Ogburn, Bucknell University, was presented by Professor Kintner in the absence of the author. These papers were of very considerable interest and were well received.

Those on "Demonstration Teaching in Laboratory Practice," "Co-operative Industrial Contacting," and "Chemical Engineering Laboratory Notebooks and Texts" in particular aroused special interest and elicited much discussion and comment. Professors Coles, Elgin, Hougen, Hodge, Janness, Kintner, Koffolt, Molstad, Shreve, Stewart, Vilbrandt, Weitz, and Whitwell contributed to the round table discussion of these topics.

As a result of the discussion of Professor Ogburn's paper and the other aspects of chemical engineering laboratory work a motion was unanimously passed by the conference requesting that the Chairman appoint a committee on chemical engineering laboratory methods and procedure to study this question and report at the next conference on chemical engineering held by the Society.

A resolution expressing the appreciation of the group to the Society, President Wickenden, the Conference Committee, and Cornell University for making possible the conference was unanimously voted.

JOSEPH C. ELGIN, *Secretary.*

CIVIL ENGINEERING

Following the suggestion of President Wickenden, Engineering Economy was chosen as the general subject for the Conference. The general subject was presented under five headings by five individuals eminently qualified to present the respective phases of the subject taken up by them, at a conference held Wednesday evening, June 20.

B. R. Van Leer, University of Florida, discussed "Teaching Economics through Hydraulic Design." In the introduction to his remarks, he expressed emphatically his objection to the view that engineering and economy may be separated.

Ivan C. Crawford, University of Idaho submitted a paper (read by J. Hugo Johnson of that Institution in Dean Crawford's absence) under the heading "Financial Planning for Municipal Water Supplies." The emphasis, in this paper, was on the city's financial resources.

"Economic Phases of Highway Engineering in Undergraduate Civil Engineering Courses" by T. R. Agg and R. A. Moyer of Iowa State College. The discussion was presented at the meeting by Dean Agg.

William G. Grove of Robinson and Steinman, gave an interesting and lively discussion on the topic "What Problems in Economics of Structural Steel Should Be Taught to Undergraduate Students in Engineering Colleges."

The fifth paper on the program was one carefully prepared and

presented by Fred L. Plummer, Case School of Applied Science on "The Economic Phase of Reinforced Concrete Construction."

There was considerable discussion on the above papers following which the Committee presented to the meeting the question of forming a Division of Civil Engineering to take over the functions which had been performed for the past several years by the Committee. Before the meeting the Committee had drawn up a petition to the Council for a Division of Civil Engineering. After a brief, informal discussion, the Committee was authorized to present the petition, with some alterations which had been suggested in the meeting, to the Council. Accordingly, the following petition was presented to the Council at its morning meeting on June 21, 1934. The petition was granted.

TO THE COUNCIL OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION:

Gentlemen: The teachers of Civil Engineering of the Society for the Promotion of Engineering Education hereby petition the Council to authorize a "Division of Civil Engineering" to be composed of such members of the Society as may choose to join it. There are more than 400 members of the Society who would be eligible to membership in such a division.

The active governing group of the division shall be an executive committee of six members, two of whom shall be elected each year for a term of three years; except that in the case of the first annual election, two members shall be elected for a term of one year, and two for a term of two years. The two members of the executive board elected for two year terms at the first annual election shall be members of the present committee on Civil Engineering.

The officers of the division shall be a chairman, and secretary, who shall be elected annually at the time of the annual election and who shall have been members of the executive committee or members of the committee on Civil Engineering for at least one year prior to their election as officers. They must be members of the Executive Committee. No person who has been on the Committee on Civil Engineering for three years, or who has been on the executive committee for three years, may serve on the committee within two years.

The annual election of the division shall take place during the regular annual meeting of the Society for the Promotion of Engineering Education and at such time and place as may be designated by the executive committee.

The activities of the division shall be prescribed by the executive committee.

Respectfully submitted by

L. E. CONRAD,
(*for the Committee*)

June 21, 1934.

After the decision to petition for a Division of Civil Engineering, arrangements were made for a business meeting to be held at some later date to elect the Officers of the Division in case of favorable action by the Council.

At the business meeting the following officers for the Division were elected: *Chairman,* Frank Kereskes, Iowa State College, *Secretary,* F. L. Plummer, Case; *Executive Board for one year,* T. R. Agg, Iowa State, and Gordon M. Fair, Harvard; *for two years,* Frank Kerekes, Ames, and F. L. Plummer, Case; *for three years,* L. E. Grinter, Texas A. & M., and K. C. Reynolds, M. I. T.

L. E. CONRAD, *Chairman.*

MECHANICAL DRAWING AND DESCRIPTIVE GEOMETRY TEXTS EXHIBIT

From various Engineering Libraries, from many interested and accommodating publishers, and from the private collections of several kindly spirited members, nearly 300 volumes of texts on these two subjects were assembled and placed on display in Room 204, Sibley Building, being open to visitors, casual spectators and critical and examining and admiring friends during all recesses between sessions of the convention. The books chosen were representative, covering periods of publication from the earliest obtainable down to the very latest. No attempt to make the list complete was felt desirable at this time, so far as collecting and exhibiting the texts was concerned, although the committee did try to obtain as complete a bibliography as possible, and now have record of more than 500 volumes.

The exhibit included treatises in French, German, Spanish, Italian and Latin, in addition to the many by American and British authors. The oldest and rarest book on display was Durer's "The Proportions of the Human Anatomy," which contains many illustrations consisting of orthographically projected third quadrant views of the human figure and of parts thereof with all projecting lines shown, thus anticipating Monge's work so far as the use of projected views is concerned. This does not detract, however, from his credit and fame as the discoverer or inventor of the theory which employs such views for the solution of space problems.

As to the content of the books presented, it is noteworthy to observe that the first edition of Monge covers practically all the theory that has ever been evolved by Descriptive Geometricians. True, there have been vast areas of application of theory to more or less practical engineering problems, and countless pedagogical devices have been written about which are intended to make the theory more attractive to the student. But the fundamental space rela-

tion problems can mostly be traced back to one or another of these classic old tomes that were contemporary with that of Monge.

The committee recommends that the bibliography of our field be made as complete as possible and distributed to the members, who will then be asked to augment it by suggestions of works not discoverable by the committee. At a later date, an assembling of the entire list might be attempted, to be made available to members for research at some convenient repository such as the Congressional Library.

The collection of historic materials of any kind is somewhat like the proverbial job of finding needles in a haystack. Although the job of the committee was doubly complicated by the requirement that the collection of drafting tools we found had to be displayed in a certain manner, that task, fortunately, was ably handled by Professor Townsend of Cornell. The glass display cases he constructed were most suitable for the objects collected. This division, as well as the S. P. E. E., is deeply indebted to Professor Townsend for his wholehearted coöperation. Many of the objects could not have been shown if glass cases were not provided, since the contributors distinctly stipulated that their objects must be displayed under glass.

The most trying part of the job of the committee was to locate the historic drafting tools in the various parts of this country and in Europe. Our first thought centered around the 190 engineering institutions in the United States and Canada. To them we sent letters and their replies proved fruitful.

To about eighty of the older industrial engineering firms of the United States, the committee sent letters of request for historic drafting tools which either the firm or their employees possess. Their replies were coöperative in tone, but actually they had practically nothing to offer. One manufacturer of drafting materials holds the policy of destroying old and useless products about the shop. Such practice makes it quite impossible to collect objects which depict various stages in the development of drafting tools.

To assemble the objects for the drawing instruments exhibit, over 500 letters were mailed to various sources.

The committee wishes to thank all those who have contributed to the exhibits materially and also to those who encouraged it.

The collection of historical drawings proved interesting as well as instructive, and efforts will be made to make it permanent. The Museum of Science and Industry will gladly give the space necessary for its installation.

Firms and museums coöperated generously to the collection of old and rare engineering drawings, especially Westinghouse, Winchester Arms, Stanley Works, Brown and Sharpe, Corliss Engine,

American Bridge, Yale and Towne, and Seth Thomas Clock Company. The collection included a working sketch on stone by an Egyptian architect, a collection of rare drawings from the Smithsonian Institute, copies of the original drawings of Fulton's steam boat and of the earlier locomotives, an interesting color drawing from the Nystrom Collection of engineering drawings, and four of the original drawings of the dome of the United States capitol building.

Besides these chronological historical drawings there were numerous drawings of individual interest, including a cattle mill (1854, loaned by Brown University), a very beautifully executed truss bridge in colors (1869), and drawings made by such famous engineering personalities as Charles M. Schwab and Julian Kennedy. Two finely executed working drawings made on wooden boards, shellacked for preservation, executed about 1860, from the Yale collection, excited great interest, as did the first sketch of Edison's phonograph, which showed that the great inventor cared little for drafting frills.

Detailed reports of the various sub-committees will be made available for all members of the Division of Drawing and Descriptive Geometry in the very near future.

H. M. McCULLY, *Chairman.*

COOPERATIVE ENGINEERING EDUCATION

The conferences of the Coöperative Division preliminary to the General conferences were held June 20, 21. Much interest and enthusiasm was evinced throughout these meetings on the reading and discussion of the scheduled papers.

Dr. Coleman of Berger Junior College, New Jersey, opened the meeting with an excellent paper on the coöperative commerce course as compared with the traditional or four-year commerce course. In his six-year thorough study of the two kinds of education he disclosed that sixty per cent of students in the traditional course average twenty-five months net time of employment between college entrance and graduation, which is only about five per cent less time than the coöperative students put in practice work. However, the coöperative students are under a supervised program of work which is conducive to their course of study whereas the traditional students are under no prescribed program, having to do any and all kinds of tasks from waiting on tables at a restaurant to tutoring children or acting as custodian on the premises of some building or in some plant. He also said that the traditional course students who do part time employment are in college before gradu-

ation practically as long as the coöperative students, the average age of the former at graduation being 23.2 and the latter 23.8.

The second paper by Professor Metzenheim of Newark College of Engineering, too, was very interesting, since he explained the evaluation of coöperative academic credits, which always evokes much debate and many lively discussions. He used a new unit known as the kilo minute or one thousand minute unit of time devoted to actual instruction in classroom or laboratory for measuring the quantitative element in academic credits. In a comprehensive and representative study of engineering curricula both of coöperative and non-coöperative colleges he found that the time for academic instruction was about the same, any variation having a little more academic instruction attached to the coöperative program. He also showed that the coöperative colleges base their evaluation and accrediting of degrees on the academic content of courses given. He stated, however, that the practice experience in the industrial field was extremely valuable and an inherent part of educational procedure.

The third paper by T. A. Johnson, Electrical Engineer of the Central of Georgia Railway Company, created unusual interest. Mr. Johnson narrated the long history of coöperation between the Central of Georgia and the Georgia School of Technology, bringing out the many favorable points of the Coöperative Plan to the railroad industry. He stated that his company was well satisfied with the work of the Georgia Tech coöperative students, feeling that the students rendered better service than the average shop apprentices. He also explained how his company shifted the students about on the different kinds of shop work over their five-year Coöperative Plan and how his company promoted the healthful and wholesome feeling between the permanent shop employes and the coöperative students. He concluded his paper by stating that his company was so gratified over the services of the students that in recent years it had inaugurated with the Georgia School of Technology a plan to award certificates at the Georgia Tech Commencement exercises to the coöperative students who had satisfactorily completed their services with the Central of Georgia Railway Company.

The fourth and last paper was read by R. W. Renn of the University of Cincinnati. Professor Renn had an excellent treatise on the various kinds of civil engineering work for coöperative students. He explained how necessary it is to find a certain type of student who has aptitude for some particular kind of work. He also brought out the many points showing how sequential training with one firm is not so common as in the electrical and mechanical engineering fields. Oftentimes a student may start as a laborer

on a building construction job and in time become a straw boss; later he could be placed on highway construction work as a rodman, instrument man, etc. Before he completes his college course he might have experience in some public service, federal, state, etc.; as a senior he could be useful in a consulting office where he could make estimates and surveys on some project. Professor Renn made his paper particularly interesting in showing the different trends in the civil engineering field from 1925 up to the present time, concluding by noting the unusual opportunities both for undergraduates and graduates in government work of all kinds.

J. E. McDaniel, *Chairman.*

DEANS AND ADMINISTRATIVE OFFICERS

At the meeting of Deans and Administrative Officers, Vice-President B. M. Brigman presiding, Mr. L. W. W. Morrow, Managing Editor, *Electrical World*, gave a paper on "Occupational Demands," about which the discussion of the session clustered. Mr. Morrow stated that opinions as to the future demands for engineers might be grouped into three classes as to primary demand with a secondary demand recognized by all three.

First is the belief that engineers virtually hold the key to future advances in the standards of living and in improved social relations. Second is the view that industries have already become largely mechanized and will become even more so, causing a large demand for operators and managers not now satisfactorily supplied by engineering colleges. The third view is that industry will require a relatively few highly trained engineers to do its diverse developmental work and that the large block of training should lie along business lines. In any case, all recognize that the marketing of engineering products requires a multitude of men having fundamental scientific and engineering knowledge with a high degree of specialization in each branch and functional division of industry.

The new conceptions of engineering go beyond the old idea of applied science and contemplate the active participation of engineers in the advance of man's social life and the control of his environment. This ideal invests engineering with a new dignity and utility. This new conception has been largely depression-born. Leaders in engineering and in engineering education must carry out these new concepts or else prove them invalid.

The present and probable future demands of industry indicate the need of preparing two types of men: (1) a large number with a broad training including some fundamentals of engineering to fill the functional positions, and (2) a small but highly trained group for technical developmental work. Engineering schools

might well aim at the preparation of these two types of men according to this pattern.

Mr. Morrow's paper was followed by discussion.

President W. E. Wickenden outlined the combined commercial and engineering courses at Case, administered by a committee from the departments concerned. He pointed out the danger of a specialized curriculum of this sort with a departmental head who, as a propagandist, might give it undue emphasis in his enthusiasm to make his work successful.

T. R. Agg (Iowa State College) discussed the adjustment of two years' general study in junior colleges with the engineering course. He advocated counting on graduate study for much of the technical instruction.

F. E. Turneaure (Wisconsin) believed that engineers should feel complimented by the critics who say in effect that the engineers have been too efficient and have advanced technology beyond the bounds of social and political attainment. He stated that the demands of recent years have produced a somewhat unbalanced crop of engineers. He did not advocate "plowing under" however.

C. H. Michell (Toronto) stated that the more severe entrance requirements at Canadian institutions had diminished the number of young engineers somewhat, a mild form of "plowing under" the marginal capabilities.

H. C. Sadler (Michigan) described the combinations of engineering with law, conservation and forestry, and education existing at his institution.

A. M. Greene (Princeton) stated that his university gave attention to preparing men to enter supplementary fields and called attention to the value of emphasis on the scholarly aspects of the liberal arts.

A. M. Dudley (Westinghouse Company) said that industry was making an effort to obtain graduates from the top quarter for developmental work and to permit others to enter application, works management, and sales. He emphasized that the successful executive is born not trained. The decentralization of industry is demanding more all-round men.

B. R. Van Leer (Florida) took a conservative view averring that he was not interested in merely producing more engineers. He believed that sufficient technical training could be placed in the last two years.

S. B. Earle (Clemson) agreed with Dean Greene with regard to the responsibility for a careful selection of students and thought that attention should be given to preparation for supplementary fields.

P. R. Kolbe (Drexel) pointed out the possible objections to the establishment of junior colleges by large universities as chain-education.

H. S. Rogers (Brooklyn Polytechnic) voiced the hope that a satisfactory engineering course might be composed of two more generalized years followed by two specialized years.

A. S. Langsdorf (Washington University) remarked on the advantages of a supplementary general B.S. course that could be utilized to prepare men for pursuits allied to engineering and urged the regrouping of students at the end of the first two years on the basis of ability.

J. H. Bangs (Cornell) related his experience with an industrial option in which the mathematics requirement served as a filter to eliminate the inept.

E. R. Cary (Rensselaer) explained the working of the B.S. course at R. P. I., stating that a large proportion of the so called "lame ducks" made good in commercial life.

W. C. Bauer (Northwestern) analyzed the operation of the five year course, observing that 55 per cent remained for the fifth year and that the five year men exceeded the four year men in earning power.

C. F. Scott (Yale) asserted that engineering education is primarily education rather than a training to pass licensing examinations.

The chairman closed the discussion with an apt story that indicated some danger to the course from too much dilution.

C. C. WILLIAMS, *Secretary.*

ELECTRICAL ENGINEERING

The sessions opened with an introduction by Chairman Johnson, who outlined the program sponsored by the Committee on Electrical Engineering. He then presented the first speaker of the morning session.

For and Against Turnover in Staff, by E. E. DREESE

Professor Dreese's first concern was with the definition of turnover, as he desired to discuss not only the hiring and firing of men but also what might be called its broader aspects, such as internal staff turnover, and intellectual turnover in an individual.

As far as the hiring and firing of men was concerned, this was frequently brutal and often unsocial. It sometimes had to be done but there were means of accomplishing it with the minimum of brutality, such as personal conferences with individuals in which

they were advised that promotion seemed unlikely and that they would do well to look for another job, this notice being given them a year or more in advance of any definite intention to dispense with their services. Another means of accomplishing this was the use of leave-of-absence for work with industrial concerns which produced a permanent outside industrial connection.

The frequency and necessity of "hiring and firing" was far less than the other aspects of turnover, namely that concerned with the men on the staff and the ideas in individuals' minds.

Definite advantages seem to come from passing certain administrative duties and teaching assignments about in the staff and not allowing these to become vested interests of certain individuals. The assignments are left—if this seems necessary—a sufficient length of time so that as much value as possible can be obtained from the experience of the individual with the work in question. It is a matter of balancing the advantages of a fresh point of view and new ideas against intimate knowledge based on long acquaintance. The latter seems often to result in an inability "to see the woods on account of the trees." Teaching assignments in specialized professional fields were not good subjects for rotation but for all elementary and fundamental courses there seems to be distinct advantages.

Another form of turnover in staff consists of exchanges of men with other institutions such as is this year being initiated between M. I .T. and the Department of Electrical Engineering at the Ohio State University. Such exchanges would seem to offer much and should be more general.

Along this same line there seems to be no reason why a certain turnover in staff should not be obtained by the appointment of student-assistants from outside institutions rather than from the body of graduates of the school in question. At the Ohio State University 2/3 of the student-assistants are taken from outside schools and it is hoped that the institutions from which they have been taken will feel moved to employ Ohio State graduates, which up to the present time has not been the case on a 50–50 basis. This, however, has not prevented the policy from being continued and Professor Dreese believes the educational advantages secured for the institution generally from this plan outweigh the present injustice which appears to be done to Ohio State's own graduates. He feels that the scheme will ultimately be taken up by all other schools.

The third aspect of turnover, dealing with an individual's mind can frequently be accomplished right on the ground, if opportunity for exchange with other institutions is not readily available. Changes in administrative and teaching assignments contribute to

the stimulating process, contact with industry may likewise have a beneficial effect, research work of suitable character very frequently means new points of view, while the giving of graduate courses and supervision of graduate theses provide a fruitful source of mental development. Finally, contact with educators both in engineering and in other fields very frequently serves to increase the individual's stock of ideas.

What a Department Head Owes His Staff, by A. D. Moore

Professor Moore began his talk by endorsing whole-heartedly the preceding remarks of Professor Dreese. He then started the consideration of what a department head owes his staff by stating that the same principles of leadership that apply to any industry should be employed. The head of a department should: Find out what each man is thinking, discover his technical activities outside of his assigned work, encourage him to pursue worthwhile interests, and give him a pat on the back when his work on assigned tasks merits it.

In an educational institution the military system which prevents privates from addressing officers above their captain, is out of place, and a department head should encourage his men to get acquainted with the dean so that they can have one or two conferences with him each term. The feeling should not exist that to talk with the dean will cause the head of the department to feel that he has been "passed over."

The staff head owes to his able men the duty of eliminating the misplaced and unfit on the staff as well as the duty of careful selection of new members of the staff.

The head of the department in an engineering school should resist vigorously any effort on the part of the college of education in the same university or university administrators to put on the books any rules or regulations requiring staff members to have advanced degrees. This requirement as far as the teaching of engineering is concerned is entirely without significance.

In selecting new members for the staff, the department head would do well to pay some attention to the socail suitability and general fitness of the candidate's wife to become a member of the University community. In the case of a single man on the staff who is contemplating matrimony, the head of the department should have such a relationship to the man that the suitability of the intended wife as a member of the college community can be discussed.

In order to properly stimulate and develop men in the department, the head should make it possible for the men to get away

easily to attend worthwhile meetings or to visit important industries that may have some association with the men's teaching assignment or his field of research interest.

What a Department Head Owes His staff, by D. D. EWING.

The best plan for a department head to follow in dealing with his men, thought Professor Ewing, was the "golden rule." It was unfortunate that the common view of staff members is that deans and presidents are people who get you things, rather than men who are interested in helping you secure a better job or get more out of life generally. The staff head, who is necessarily more concerned with administrative things than teaching, should not allow this to overbalance in his mind the importance of good teaching. He should remember that the teacher is always more important than the curriculum content; in many cases it would make no difference what the subject matter studied was if the course was given by an outstanding teacher. The staff head should be less concerned with the amount of ground covered and the topics in the course syllabus, than with the enthusiasm of the teacher for the subject generally, and in particular with the interest and joy which the teacher has in associating with young men.

Frequently young instructors or assistants lack tact in dealing with students, but to the extent that it is feasible, the staff head should back up arrangements made by instructors with students, pointing out in private conferences with the instructor the errors which he may have committed.

The head of a department should realize that excessively long hours sometimes spent by young instructors on research problems or on graduate study saps the energy and vitality, and even perhaps the enthusiasm which they need to face groups of students. Where research work is done, credit should be given to the men who actually do the work rather than to have the department head demand a joint presentation or even in an extreme case to "hog" credit for the whole thing himself.

An ideal which a staff head might well set for himself is that he is developing the best possible engineering teachers, not necessarily for his own institution but for the country as a whole. Should requests come to him for recommendations of younger men, he ought not hesitate to recommend his best men for other jobs, though it means the trouble of breaking in another man in the place of the one who leaves. If a staff is suitably arranged and thought given to such matters, it should be possible to move up men in such a way that the difficulty occasioned by the loss of an experienced man is a minimum.

The Delegation of Responsibility and Results, by J. M. BRYANT

Professor Bryant read from manuscript and so no notes were taken on his talk.

General Discussion

The time available for general discussion at the close of the morning session was quite limited and only a few had time to speak. The observation was made that in hiring student-assistants a certain duty was felt by some schools towards their own graduates and that the proportion of 2/3 mention by Professor Dreese would be considered too high, 1/3 being more the order of magnitude in the school from which the speaker came. Another speaker referring to the delegation of responsibility, deplored the fact that large amounts of administrative work were sometimes not adequately taken into account in calculating instructional loads.

WEDNESDAY AFTERNOON SESSION

The afternoon session was opened by Chairman Johnson who repeated the general announcements made at the beginning of the morning session, and then proceeded with the program, presenting Mr. M. M. Boring of the General Electric Company.

The Demands of the Times, by M. M. BORING

Mr. Boring prefaced his remarks on engineering education by pointing out that saturation in the use of electric power was much closer today than it was twenty or even ten years ago, and hence fewer opportunities for employment of engineering graduates would exist in the Central Station industry particularly as far as the construction of facilities is concerned, and as well in industrial applications of power. There would still be some activity, but the amount of this work to be done in the future would be far less than it had been in the past. There was coming, however, a development in the domestic use of electricity which might be viewed as phenomenal. It was possible that air-conditioning would lead the way out of the depression and there would be a field here for many engineering graduates, particularly electrical graduates, to go into this work if they seized the opportunity.

One lesson the industries employing engineering graduates had learned from the depression was the necessity of eliminating the unfit from their staffs before they had stayed too long and gotten into ruts from which they can never be extricated without serious damage to themselves. Only the very best of the engineering graduates will be employed by companies in the future, as the demand

for engineers will be so much smaller than it has been in the past that they will be able to exercise a far higher demand of selection.

As the engineering schools are still turning out about as many graduates as they were in 1928–1929 what will happen to those not employed by the big companies? Many solutions are offered but Mr. Boring proposed that there should be a place for a consulting engineer in almost every community of 3,000 or over, population. He should be able to secure remunerative employment, and render the public as valuable a service as a doctor or lawyer. Communities of 3,000 usually support several men in the latter professions. A large amount of educational and missionary effort with the public would be necessary to convince people of the value of paying for the advice and services of such a consultant, but with the increasing technical complexity of everyday life, the possibility of earning a living in this way becomes daily more realizable.

If the engineering educators were to make a change in their curriculum based on the employment which the big companies expect to be able to offer, they would drop any courses dealing only with electrical railways, unless they were of such a general character that they really comprised exercises in applying fundamental physics and mathematics. It would be worthwhile to instruct but very few students in the details of electrical railway practice.

To show what engineering graduates were doing, Mr. Boring presented some figures dealing with the situation in the General Electric Company. There were on September 30, 1933, 1,288 engineering graduates employed by the General Electric Company in Schenectady. Of these, 245 were in sales work, 22 were accountants, 55 were engaged in legal and patent work, 13 in the supervision of manufacture, 13 in the publicity department. Most of the preceding had no need for any specialized courses of subject matter dealing with any particular field. Besides those in the preceding list there were the men who are engaged in more strictly engineering work: 171 in application engineering, 80 in the general engineering laboratory, 61 in the research laboratory, many of these dealing with electron tubes, and 329 in the design department of which latter number, 125 were in training for the sales or application departments. The Schenectady manufacturing organization had 121 men, of whom only 61 had any need for machine-shop work or specialized courses in technical subjects. There were also at this same time 180 on the student test course. In the future, thought Mr. Boring, fewer of the highly theoretical type will be needed, as much research is being done by those who are graduates in physics rather than those with engineering degrees.

Turning to another topic for a moment, Mr. Boring stated it as his opinion that not enough students were eliminated from engi-

neering courses—and for that matter, from universities generally—on account of poor personality or inability to make social adjustments such as are almost always required of the professional man, unless he be a distinct genius who can be shut up by himself to work out problems alone.

In describing the employment of his company, Mr. Boring stated that this year he was hiring 150 men from the several thousands who have been interviewed over the last three or four years. The 150 whom he hired were distributed over the graduating classes of the last several years, as the company felt it would be advisable to have men from all of the different age levels rather than to have the period 1930–1934 constitute a distinct break. Of the large number applying, fifty or sixty were the sons of important officers, vice-presidents and the like, of corporations with which the General Electric Company has business relations. It was the decision of the Sales Committee of the General Electric Company that no one should be employed except on his own merits. Commercial relations had nothing to do with the hiring of the 150 men taken on this year.

Mr. Boring emphasized the importance of a social point of view on the part of the engineers, that community activities cried for the need of his factual approach and the lack of emotion that should characterize his dealings with problems of general community importance. He thought that much more attention should be devoted to such matters as Economics and Sociology than has been customary in the past.

In conclusion he stated that the General Electric Company would not in the future employ as many engineering graduates as they had in the past, and that those who are hired must be definitely superior both in personality and in academic attainments and keenness of intellect.

Report of Committee Survey on "Economics in Electrical Engineering"

Chairman Johnson reported the results of the questionnaire sent to various institutions and as this will undoubtedly be published later, no notes were made of the figures presented.

Reports by Speakers from Different Institutions on "The Teaching of Engineering Economy"

The remainder of the afternoon was devoted to a series of brief reports by speakers from different institutions that have made special moves in regard to engineering economy. Some interpreted the Chairman's request for a discussion on this subject as dealing with curricula specially set up for industrial and administrative

engineering while others discussed the economic content of electrical engineering courses of four and five years length.

Morland King of Lafayette College

Reported that the degree at Lafayette in administrative engineering has been abolished, that options involving economics and business administration have been incorporated in the mechanical the electrical engineering courses starting in the junior year. The first two years are the same for students who take the administration and technical options. The basic technical courses will be the same in both options but advanced technical courses will be omitted in the administrative option, as for instance, differential equations will be omitted in the electrical engineering administrative option, and psychology and accounting substituted for it.

H. W. Bibber of the Ohio State University

Described the teaching of engineering economy in the electrical engineering course at the Ohio State University, from manuscript which was submitted to the chairman.

C. F. Harding of Purdue University

Spoke of an elective course running throughout the senior year which dealt with electrical engineering economy, in many ways similar to the one quarter course described by Professor Bibber but covering more ground due to the longer time available. The effort made at purdue was to have the students in the electrical engineering who were interested in the economic and administrative side of the industry choose electives in those fields.

D. D. Ewing of Purdue University

Told of the request of outside interests to put in a curriculum there in administrative engineering. A survey showed the doubtful character of many such courses in other institutions. The faculty committee appointed to consider the possibility of such a course did not wish to report unfavorably, though the real committee feeling was distinctly against such a curriculum. The policy pursued, therefore, was to report the curriculum favorably from the committee, but to accompany it by a report giving the results of the investigation so that the faculty could study the points involved and a final decision be made by the entire body.

In its investigation the committee of which Professor Ewing was a member, was frequently assured by alumni and others that the engineering courses as now being given constituted a good preparation for work in administration, sales, or production, and that the necessity for setting up a special curriculum appears to be less than some of its proponents maintained.

F. Ellis Johnson of Iowa State College

Described the manner of liberalizing the electrical engineering curriculum at his institution by an analysis of the employment and functions being performed by graduates. This list was submitted to the heads of different departments of instruction, and they were given the opportunity of indicating what their courses would do for students entering fields similar to those shown in the employment analysis. This seemed to stimulate the interest of other departments in courses taken as electives by E. E.'s. The electives open to students in electrical engineering are protected from being "snap" courses by a carefully chosen list, and the approval of the student's advisor as to his choice of electives.

W. T. Ryan of the University of Minnesota

Reported on a combined engineering and business administration course covering five years at Minnesota. The student must complete the regular curriculum in electrical engineering in order to get the B.Sc. in business administration thereby protecting the engineering content. The business subjects begin at the second year. The same technical courses are required as in the regular engineering curriculum. There is thus secured a combination of business and engineering which avoids the criticisms of many industrial engineering courses.

At an informal dinner meeting on Thursday, A. C. Stevens, General Electric Company, spoke on "The Share of Industry and the Professional Engineer in Engineering Education," and Vladimir Karapetoff, Cornell University, spoke on "Wine Makers and Bottle Makers." At a conference for young instructors on Friday, R. E. Doherty, Yale University, spoke on "Winning Promotion."

H. W. Bibber,
Secretary.

ELECTRONICS AND ELECTRICAL COMMUNICATIONS

The conference meetings on the teaching of Electronics and Electrical Communications were held in Franklin Hall with W. L. Everitt of Ohio State University presiding. Five sessions were held with seven papers delivered as indicated below. The meetings were attended by eighty-five representatives of forty-nine organizations, and a large number took part in the discussion of the papers.

Laboratory equipment was exhibited by seven institutions as detailed later in this report.

Trips to the Cornell Broadcasting Station and Studios were made available to those attending the conference.

The following program was presented:

Tuesday, June 19, Symposium on graduate work, lead by Edward Bennett, University of Wisconsin, and discussed by E. E. Dreese, Ohio State, H. W. Bibber, Ohio State, E. A. Guillenim, M. I. T., W. G. Dow, Michigan, H. A. Brown, Illinois, J. O. Perrine, A. T. and T. Co., G. B. Thomas, Bell Tel. Lab.

Relation of the Communication Field to the Electrical Engineering Curriculum, led by M. P. Weinbach, University of Missouri.

Selection and Development of Teachers for Electrical Communication, led by O. W. Eschbach, American Telephone and Telegraph Company.

These papers were discussed by W. G. Dow, Michigan, H. J. Reich, Illinois, M. C. Hughes, Texas A. and M., H. A. Brown, Illinois, F. H. Pumphrey, Rutgers, A. A. Nims, Newark Col.

Wednesday, June 20, A Symposium on Course Content, led by H. R. Mimno, Harvard University, and discussed by C. E. Tucker, M. I. T., H. J. Reich, Illinois, H. E. Hartig, Minnesota, J. G. Brainerd, Pennsylvania, E. A. Guillenim, M. I. T., W. A. Murray, Michigan State, W. M. Hall, M. I. T., H. A. Moench, Rose Polytechnic, W. G. Dow, Michigan, J. R. Martin, Case, Knox McIlwain, Pennsylvania, C. L. Dawes, Harvard.

Sources of Material for the Development of Subject Matter in Electronic and Communication, led by H. E. Hartig, University of Minnesota.

Application of Communication Techniques to other Fields, led by E. B. Kurtz, University of Iowa, and discussed by J. R. Martin, Case, H. A. Brown, Illinois, C. E. Tucker, M. I. T., H. J. Reich, Illinois, W. G. Dow, Michigan, True McLean, Cornell, W. M. Hall, M. I. T., J. F. Byrne, Ohio State, H. A. Moench, Rose Polytechnic, J. L. Reinhartz, R. C. A.

Thursday, June 21, Symposium on Laboratory Equipment and Practice, led by H. H. Newell, Worcester Polytechnic Institute, and discussed by E. E. Tucker, M. I. T., A. A. Nimms, Newark C. of E., J. F. Byrne, Ohio State, J. G. Brainerd, Pennsylvania, J. E. Mulligan, M. I. T., B. K. Osborne, Michigan State, R. W. Warner, Kansas, H. A. Brown, Illinois, W. M. Hall, M. I. T., W. G. Dow, Michigan, H. J. Reich, Illinois, H. A. Moench, Rose Polytechnic, J. R. Martin, Case, R. M. Hull, Idaho, True McLean, Cornell, L. Kahn, Rutgers.

Exhibits.—Exhibits of laboratory apparatus were made showing equipment, experiments and projects by various schools and commercial organizations.

All exhibits were in charge of Professor True McLean.

J. R. MARTIN, *Secretary.*

ENGINEERING ECONOMY

The meeting was held on June 21 and was opened by Dean Kimball who then turned it over to Professor M. A. Lee, as chairman.

Papers were read by P. T. Norton, Jr., and James K. Finch. Informal talks were given by D. B. Prentice and A. B. Domonoske. A report was also made to the meeting of the proceedings of the preceding session on Engineering Economy.

The discussion was opened by Professor Rautenstrauch who argued that we were concerning ourselves with "piffling points." We must realize, he said, "that our job was to prepare men to help build a culture."

Professor Norman, following the same line of thought, said we must realize that our time was short. We were facing the possibility of a radical revolution and that such things, when they came, moved with great rapidity. He was born, he said, in Sweden, under what was essentially the feudal system and already there had been six socialistic governments there. The present depression, in his opinion, was so much deeper than earlier ones as to indicate that it was the beginning of the breaking up of the capitalistic system, as we had known it.

President Prentice argued that the previous speakers had painted the existing system in colors too dark. He instanced his father's and mother's families which had lived for three hundred years in this country under that system without either producing a man of great wealth or one who became a public charge.

Dean Norris spoke of the difficulty of teaching engineering economy in this time of rapid and perhaps fundamental change. He raised the query as to how far the concepts of profit, interest, etc., would carry over into the possible socialistic future. Mr. Norman said he thought all these were names for things which would be socially significant in any economy and that if we were careful to get beneath the label and make clear the essence, the ideas which the student acquired would be serviceable whatever the system which emerged from the present ferment. Professor Rautenstrauch again emphasized that the proper aim of a teacher, whatever the subject, is to lead the student to develop ability to formulate properly the problems which come to him, to collect information, to make the necessary effort to insure that no essential information has been ignored, and then to deal with that information critically, logically, and without prejudice. If the teacher has performed this job well he need not worry about the effects of external changes.

A number of short contributions to the discussion were made by various speakers. There seemed to be unanimous agreement

that there should be a basic course in general economics taught not from the point of view of the engineer, as such, but from that of the economist, though there appeared to be considerable impatience with certain attitudes of mind and specific ideas which speakers attributed to economists.

Professor Rautenstrauch moved the adoption of the following resolution which, after some discussion, was carried:

"Resolved that this conference request the council of the S. P. E. E. to arrange a panel discussion on education to be held at some future meeting of the society and that a recognized Professor of Education be invited to organize and conduct the panel."

(Professor Rautenstrauch recommends that Professors Harold Rugg and George Counts of Teachers College, Columbia, be invited, the former to conduct the panel and the latter to give the address.)

S. S. GARRETT, *Secretary.*

ENGINEERING RESEARCH

A very successful session on Engineering Research was held on Thursday morning, June 21, which was attended by 60 members. The attendance was somewhat limited as the result of parallel sessions of interest to deans, administrators and instructors of electronics. However, the interest in and possibility of discussion made possible by the conference methods adopted at this convention were generally considered to neutralize the handicap of simultaneous meetings.

The generous response of all authors resulted in the presentation of five papers covering practically all phases of coöperative research with industry. These were followed by a general discussion, available to all members, an opportunity seldom available at the large meetings of earlier conventions.

The summary of the survey being made by Dean J. W. Barker of Columbia, for the National Research Council, of the available research equipment and personnel at the various educational institutions looking toward the better coöperation with industry was of particular value.

It is recommended that this summary and the response of Director Maurice Holland to the several requested comments of research executives upon the handicaps now experienced in coöperative research may be published in the Journal of the Society in the near future.

Further discussion of particular interest pertained to the various methods used in dealing with patents resulting from coöperative research and the equitable treatment of graduate students and other research personnel who become inventors under such projects.

C. FRANCIS HARDING, *Chairman.*

FLUID MECHANICS

The scheduled program of this section of the conference began on Tuesday afternoon, June 19, and ended with a Thursday morning session. The programs were varied in scope and interesting.

In the first meeting a general presentation was given of the content and scope of fluid mechanics in undergraduate courses. The first paper, "An Industrial View of Hydraulics Instruction," presented the viewpoint of an engineer in industrial research, C. F. Merriam, Pennsylvania Water and Power Co. The speaker advocated general courses of a fundamental character but specified that they should contain up to date material. He stressed also the vital importance of the part that the teacher's personality plays in the development of latent potentialities in his students.

The next paper on the "Scope of Fluid Mechanics Courses," by M. J. Thompson, University of Michigan, began with a historical preface on the subject. He called attention to the impractical character of certain parts of classical hydrodynamics for engineering students. Credit was given to civil engineers who were responsible for most of the instruction which has formerly been given in fluid mechanics. He mentioned more recent theoretical results and their applications which should be included in a modern course. The speaker advocated a course beginning with the third year of undergraduate instruction. He stated that the emphasis should be on the fundamentals of mechanics and physics as applied to fluid mechanics. R. W. Powell, Ohio State University, spoke next on "Prerequisite Courses." The author's own summary is admirable: "Fluid mechanics should be a branch of mechanics, which is a branch of physics as well as a branch of applied mathematics. It should be a separated portion, with its own definite field, but it should join these other fields along as long a common boundary as possible, and on the same level, so that the student's mind can range from one to the other without the least discontinuity."

"The Relation of Fluid Mechanics Courses to Mechanical Engineering Courses" was then presented by A. H. Blaisdell, Carnegie Institute of Technology. Briefly he showed that the courses in engineering thermodynamics, advanced design (or theses) and mechanical engineering laboratory practice require, for real comprehension, considerable knowledge of the basic principles of fluid mechanics. The paper mentions specific applications which have been gone into very thoroughly by the author.

The concluding paper, on the "Relation of Hydraulics to Fluid Mechanics," was given by S. B. Lilly, Swarthmore College. The author gives sound reasons for changing our classical courses of yesterday in this present, changing era and submits as a proposal

that hydraulics be given to engineering students first and then a general course in fluid mechanics. He advocates the scrapping of purely informational and hand book types of courses if necessary, to make room for such new courses.

The evening session was held jointly with the chemical engineering and heat transfer sections. Three papers were presented. The first two, "Chemical Engineering Applications of Fluid Mechanics" by J. H. Koffult, Ohio State University, and "Hydrodynamics in Lubrication" by A. E. Norton, Harvard University, will be commented on elsewhere. The third paper, "The Hydrocal" by A. D. Moore, University of Michigan, described an experimental method, developed by the author, to measure heat transfer. This is accomplished by using different lengths of small-bore tubing through which laminar flow is maintained.

The Wednesday morning session began with a presentation of "Current Programs of Research" by W. E. Howland of Purdue University. This enabled members of the conference to exchange experiences on the spot.

K. G. Merriam, Worcester Polytechnic Institute, then offered for consideration a "Selected Reading List." This list was classified as to: Hydrodynamics, Aeromechanics, Mechanics of the Ideal Fluid. The speaker emphasized the importance of laboratory work in conjunction with classroom lectures. He showed slides of aeromechanics equipment at Worcester Polytechnic Institute and stressed the fact that much work may be done with relatively inexpensive equipment.

In the next paper on "Visualizing Fluid Flow Phenomena" P. E. Hemke, Case School of Applied Science, demonstrated with slides how fundamental fluid flow phenomena may be studied visually by means of a simple device similar to a small wind tunnel and employing titanium tetrachloride for generating the smoke.

This session ended with a visit to an exhibit of interesting demonstration and research devices.

The Wednesday afternoon session was a joint session with the heat transfer section. Comments on the papers presented are given in the report on Heat Transfer.

The concluding session on Thursday morning began with an excellent paper on "Aeronautical Engineering Applications of Fluid Mechanics" by Th. Troller, Guggenheim Airship Institute, Akron, Ohio. The author gave a brief but exceedingly thorough and scholarly summary of the problems in aeronautical engineering amenable to treatment by rational methods. He demonstrated very clearly that classical hydrodynamics is essential in the practical applications of aeronautics.

A. M. Kuethe of the Guggenheim Airship Institute spoke next

on the subject "Applications of Fluid Mechanics to Meteorological Problems." He mentioned specifically the importance of fluid mechanics in the study of: (1) General Circulation in the Atmosphere, (2) Movement of Air Masses, (3) Atmosphere Turbulence.

Spirited and interesting discussions followed the presentation of papers in each of the sessions.

P. A. HEMKE, *Secretary.*

HEAT TRANSFER

The first session, at which 57 were present, was called to order by Chairman Stewart, who pointed out that the object of the Symposium was to determine the place and scope of Heat Transfer in the curriculum and the subject matter to be included. The meeting was then turned over to F. B. Rowley (University of Minnesota), who presided over the following program:

1. Place and Scope of Heat Transfer Instruction for Undergraduate and Graduate Students in:
   - *a.* Chemical Engineering,
     O. A. Hougen, University of Wisconsin.
   - *b.* Mechanical Engineering,
     F. O. Ellenwood, Cornell University.
   - *c.* Electrical Engineering,
     A. D. Moore, University of Michigan.
   - *d.* Architecture and Civil Engineering,
     F. G. Hechler, The Pennsylvania State College.

The discussion was participated in by J. A. Fairfield, W. H. Carrier, A. D. Moore, R. C. H. Heck and W. H. McAdams; and centered about the necessity of teaching heat transfer in a thorough manner. A separate course for all Engineers including heat transfer, dimensional analysis, alignment charts and some fluid mechanics was suggested.

2. Methods of Teaching Heat Transfer, Theory and Laboratory.
   W. H. McAdams, Massachusetts Institute of Technology.

This paper was discussed by P. J. Kiefer, G. L. Tuve and A. D. Moore. It was pointed out that a heat transfer course should be unified, as simple as possible, problems should be solved, and a laboratory for demonstrating these problems should be available. F. B. Rowley closed the session with the remarks that the fundamentals should be taught more thoroughly.

The second session, at which 79 were present, was presided over by W. H. Carrier of the Carrier Engineering Corp.

1. Thermal Radiation-Methods of Investigation and Industrial

Application. R. H. Heilman, Mellon Institute of Industrial Research.

2. Thermal Radiation-Subject Matter and Laboratory Technique. H. C. Hottel, Massachusetts Institute of Technology.

These two papers were discussed by F. B. Rowley and F. O. Ellenwood. The lack of knowledge upon the phenomena of radiation among engineers emphasized the necessity of teaching this subject more thoroughly. It was suggested that on account of the lack of understanding of the exact physical process of conduction and radiation, these processes should not be taught without qualification until concrete experimental evidence is available.

3. Conduction-Subject Matter and Laboratory Technique. F. B. Rowley, University of Minnesota.

W. H. Carrier participated in the discussion, which centered on the method recommended by the Heat Transfer Committee of the National Research Council, to measure conduction. W. H. McAdams' book on Heat Transmission is a direct outgrowth of this committee's activity.

4. Convection (Natural and Forced)—Subject Matter and Laboratory Technique. W. H. McAdams and T. B. Drew, Massachusetts Institute of Technology.

A lively discussion followed, in which W. H. Carrier, J. F. D. Smith, Mr. Claghorn, T. B. Drew and Mr. Marchand took part. The difficulties involved in measuring true surface temperature and methods of applying thermocouples attracted considerable attention of the discussors.

At the third meeting a joint session was held with the Chemical Engineering and Fluid Mechanics groups. W. N. Barnard presided at this meeting. The Heat Transfer group supplied the paper on "The Hydrocal, A New Hydrodynamic Instrument for Solving Heat Transfer and Temperature Rise Problems," A. D. Moore, University of Michigan. This device was displayed and proved to be quite ingenious. Much interest was shown in the discussion which was taken part in by O. A. Hougen, Mr. Thomas and A. D. Moore. Mr. Thomas indicated that the instrument would work equally well in the solution of soil loading problems.

T. B. Drew served as presiding officer for the fourth session at which there were 98 present. The Chemical Engineering group joined the Heat Transfer group in this session.

1. Heat Transfer and the Phenomena of Evaporation. W. L. Badger, University of Michigan.

O. A. Hougen, Mr. Stewart, J. H. Koffult and Mr. Claghorn discussed this paper. Emphasis was placed upon the design and

building of equipment for evaporators. The general neglect of individual film heat transfer coefficients in Engineering Education was discussed. The tendency is to accept overall coefficients without examining the surface coefficients.

2. Heat Transfer and the Phenomena of Condensation of Pure Condensable Vapors. H. Diederichs, Cornell University.

In the discussion, participated in by T. B. Drew and W. L. Badger, the problem of true surface temperature measurement was discussed. Professor Diederichs showed a film of Drop-Wise Condensation and Mr. Drew followed with a film on the same subject, of the work done at the Massachusetts Institute of Technology. Mr. Drew pointed out that certain fatty acids and some gases will induce drop-wise condensation on film condensing surfaces.

3. Heat Transfer and the Phenomena of Condensation from a Mixture of Condensable and Non-Condensable Gases. O. A. Hougen, University of Wisconsin. Illness prevented A. P. Colburn from preparing this paper as originally scheduled.

4. Organization of a Course in Heat Transfer. E. C. Rack, Johns-Manville Company.

An excellent discussion of Hougen's paper was participated in by F. O. Ellenwood, H. Diederichs, T. B. Drew and W. L. Badger. Again much interest was displayed in the measurement of true surface temperatures. Beside the application of thermocouples, the use of an extensometer was suggested. The resistance thermometer method failed because of the problem of successfully maintaining a good electric insulation around a wire embedded in the pipe wall surface.

The fifth session was a joint meeting with the Fluid Mechanics group. F. O. Ellenwood presided at this session, at which there were 78 present.

1. What Knowledge of Heat Transfer Does Industry Expect of College Graduates in Mechanical and in Electrical Engineering. W. J. King and W. L. Knaus, General Electric Company.

It was necessary to shift this paper from the morning session, as originally scheduled, because of lack of time for presentation.

2. Dimensional Analysis. J. F. D. Smith, Harvard University.

This paper was discussed by W. L. Knaus, P. J. Kiefer and Mr. Fernald and P. A. Hemke. It was pointed out that for teaching purposes the π Theorem is preferable.

3. Effect of Heat Transfer on Flow of Fluids. T. B. Drew, Massachusetts Institute of Technology.

4. Economics of Insulation and Heat Transfer. Paul D. Close, Celotex Company.

These papers were discussed by C. H. Berry and T. B. Drew.

E. R. QUEER, *Secretary.*

LABORATORY USES OF MODELS IN STRUCTURES AND HYDRAULICS

The conference covering the Uses of Models consisted of eight sessions attended by three hundred individuals. Thirty papers were presented and were formally discussed by twenty-eight scheduled discussors in addition to a number who presented informal discussions from the floor. Two luncheons were held, the attendance in each case being limited by the available seating accommodations. An exceptionally large and interesting group of exhibits gathered by Professors Large and Powell of Ohio State University from approximately fifty individuals distributed throughout the United States and Canada, was on display during the conference.

In addition to the writer, there were twenty-six other members of the committees responsible for this conference. Each of these individuals deserves praise and thanks for his generous and intelligent coöperation. Keen interest in the program and exhibits was evidenced by the large attendance maintained throughout the conference and by the close attention given to the individual speakers.

Following a gracious welcome by Professor Ogden, the writer presented a brief discussion of the development of the use of models in teaching and research. This was followed by an excellent paper on "The Laws of Similitude" by Professor Carlson of the University of California.

The afternoon session of the Structural Division was devoted to discussions of the principles of the various methods of model analysis by Professors Sutherland of Lehigh University, Evans of Yale University, and Gilkey of Iowa State College, while the corresponding session of the Hydraulic Division was devoted to a study of "The Equipment of the Hydraulic Experimenter" and included discussions by Professors Powell of Ohio State University, Mavis of The University of Iowa, Sweetser of The University of Maine, and Schoder of Cornell University.

The Thursday sessions of the Structural Division included papers devoted to the use of various types of models in teaching and research. The speakers include Professor Rathbun of the College of the City of New York, Professor Frocht of Carnegie Institute of Technology, Professor Thompson of The Johns Hopkins University, Professor Domonoske of Stanford University who presented a paper prepared by Professor Jacobsen of the same

University, Professor Gilkey of Iowa State College who presented a paper written by Mr. Savage of the United States Bureau of Reclamation, Professor Beggs of Princeton University, Professor Karelitz of Columbia University, Mr. Johnston of Lehigh University, and Professor Timby of Princeton University who read a paper prepared by Mr. Mann of Raleigh, N. C.

The sessions of the Hydraulic Division were devoted to similar general subjects and included papers by Professor Schoder of Cornell University, Professors Hubbard and Hooper of Worcester Polytechnic Institute, Professor Barnes of Case School of Applied Science, Professors Reynolds, Camp and Hazen of Massachusetts Institute of Technology, and Professor Fair of Harvard University.

The final session of the conference devoted to present trends in teaching consisted of papers presented by Professor Morris of Ohio State University and Professor Abbott of Tufts College. Professor Hammond of Brooklyn Polytechnic Institute and Professor Young of the University of Toronto, were included among those who presented informal discussions at this session.

Professors Timby, Slantz, Reynolds and Schoder were largely responsible for the planning of the program while Professors Conwell, Burrows, Walker and Scofield handled all local arrangements for the meetings and exhibits.

F. L. PLUMMER, *Chairman.*

MATHEMATICS

Conferences on mathematics were held on June 19–20. The general topic of the conference was "Advanced Courses in Mathematics for Engineering Students." The three sessions of the conference, which were presided over by Professors H. R. Brahana of the University of Illinois, W. B. Carver of Cornell University, and H. W. March of the University of Wisconsin, were well attended and the discussions were very animated. The housing of the conference was well taken care of by Professor V. S. Lawrence of Cornell University.

Thirteen papers were read, the first being an introductory paper by the chairman of the conference, R. S. Burington, Case School of Applied Science. This paper pointed out the fact that a syllabus on the mathematics needed by the engineer was prepared by a joint committee of mathematicians and engineers appointed in 1907; that this syllabus, which included only topics through the introductory course in calculus, was published by the Society in 1912; that since the publication of this syllabus, engineering science has expanded to the point where topics in mathematics beyond the elementary course in calculus seem to be a necessary part of

the equipment of the engineer of to-day; and that the purpose of the conference was to consider the topics needed, where such topics should be included in engineering curricula, and how and by whom they should be presented.

The topics needed and used in industry were considered by representatives of a number of industries. Dr. Theodore Theodorssen, N. A. C. A., Langley Field, Va., showed how the properties of Conformal Transformation, Bessel's Functions and Integral Equations enabled the aeronautical engineer to solve the problems of air flow around airplane wings, and emphasized the need for a more thorough training in theoretical analysis as opposed to teaching a mass of detached facts in a multitude of subjects. W. R. Griswold of the Packard Motor Company pointed out the fact that courses in advanced dynamics, theory of vibrations and others of like nature were becoming more and more necessary in the work of the automotive engineer. A. M. Dudley of the Westinghouse E. and M. Company listed certain topics that the electrical engineer should know, such as Differential Equations, Theory of Functions of a Complex Variable, Symmetric Coördinates, etc., but laid greater emphasis on training the student of engineering to apply his mathematical knowledge to the solution of the numerous practical problems with which he is confronted. S. Dushman of the General Electric Company stressed the value of mathematics in setting in order the experimental facts of science, thus enabling the scientist to generalize and increase the efficiency of his experimental observations. To illustrate his point he referred to the kinetic theory of gases, which by mathematical generalization has led into such fields as Theories of Conduction in gases and metals, Statistical Mechanics and Quantum Theory. P. L. Alger of the General Electric Company emphasized the need for mathematical research which develops new symbolisms to express in simple form highly involved problems; which produces new methods for handling equations unsolvable by existing methods; and better ways of getting approximate numerical results. In his opinion the application of Tensor Analysis or Non-Riemannian Dynamics to engineering problems offers the most fruitful field of future progress.

J. B. Scarborough of the U. S. Naval Academy outlined the developments of engineering during the past thirty years and listed the mathematical topics necessary to explain adequately these developments. In his opinion about 75% of the students now taking engineering get about all the mathematics they need, but that the other 25% should have the opportunity of taking courses in Partial Differential Equations, Theory of Functions of a Complex Variable, Fourier Series, Theory of Vibrations, Elliptic Functions, Theory of Potential, Hydrodynamics, Theory of Elasticity, etc.,

and that educational institutions should make provisions for such courses.

The place where these topics should be included in the curriculum was discussed by I. S. Sokolnikoff of the University of Wisconsin and J. B. Reynolds of Lehigh University. Professor Sokolnikoff is of the opinion that the first course in mathematics following the elementary course in calculus should be of the nature of a survey course and include as many topics as possible. This course could then be followed by more substantial courses determined by the needs and desire of the students. Professor Reynolds seems to think that, in general, there is no place for advanced courses in mathematics in existing engineering curricula and that there is not much hope of their being included in such curricula. His solution is the establishment of a curriculum in general engineering with specialization in mathematics. This curriculum would stress careful analytical thinking in a few fundamental mathematics courses rather than in a number of specialized courses.

How and by whom these topics should be presented was discussed by Dean Langsdorf of Washington University, J. H. Weaver of the Ohio State University, and Philip Franklin of the Massachusetts Institute of Technology. Dean Langsdorf believes that the teaching of mathematics should be colored by the spirit of applied science, but that the "color" should be used as a stimulant outside the main trend of thought, in order to make the problem a living issue in the minds of the students. Professor Weaver believes that the teacher of mathematics to engineering students should possess the following qualities:

a) An unbounded love and enthusiasm for mathematics because of its beauty and the universality of its methods; and its usefulness when attacking practical problems.

b) The qualities of a salesman, involving a knowledge of the future possible needs of the student and the usefulness of mathematics in satisfying those needs.

To supplement these qualities he should have a thorough training in mathematics, a broad training in science and some training in the applications of mathematics to problems in industry. Professor Franklin made a plea for the policy of fostering pure mathematics in technical institutions. He pointed out the fact that this policy has rich historical precedent, that it has immediate and ultimate effects on the advancement of technology, and that it makes for better teaching.

A. A. Bennett of Brown University discussed the possibilities of mathematicians acting in a consulting capacity with industry. He discovered that there are no mathematicians in the United

States whose primary profession is that of consultant in mathematics unattached to a commercial organization, and that mathematical consulting work seems to reduce to the sporadic assistance afforded by professional teachers of mathematics to inquirers and cranks, or to the regular services of employees, particularly evident in the cases of telephone and electrical manufacturing industries.

The conference was closed by T. C. Fry of the Bell Telephone Laboratories.

J. H. WEAVER, *Secretary.*

LABORATORY PROCEDURE IN TEACHING MACHINE PRODUCTION

The conference on laboratory procedure in teaching machine production was opened by Professor R. M. Barnes of the University of Iowa, who was the conference chairman. About 40 were in attendance at the first session, Wednesday morning, June 20. Since this section was not initiated until May 1, the good attendance was rather surprising.

It gave evidence of the interest of many in this phase of engineering education. It should be noted that very few shop men were at the meetings. Great interest in this field was shown by those in *machine design, industrial engineering,* and *economics.* Also, industry was represented by prominent men from General Electric, Westinghouse, Eugene Dietzgen, and consulting firms.

The final session was somewhat smaller than the first two. While the attendance was good, it might have been much better at all sessions if there had not been conflicts in conferences, and also if a more appropriate name had been first chosen, as many thought that the conference was to be a discussion of machine shop operations.

There were many points brought up in the conference which should be of decided benefit and interest to engineering educators and administrators. These points, it is hoped, may appear later in the journal.

The real function of what has been called shop in the past, in engineering education does not seem to be as universally understood as it should be. The emphasis at the conference was laid on the properties of materials in relation to their processing and on methods of production. An understanding of these fundamentals is absolutely essential to design and to economical manufacturing. It might be noted here that some companies expect that a greater proportion of the technical graduates whom they hire in the future will be used in the manufacturing end and

fewer will be used in design and research. For the good designer it is quite evident that a complete knowledge of materials including processing is almost as necessary as for the graduate going into manufacturing.

Our students are exceedingly weak in the above respect. Proper instruction through the medium of shop laboratories should overcome this handicap, this lack of *fundamental engineering knowledge.*

Costs, values, and procedures, came in for discussion. The so-called shop laboratories are expensive. But in the reorganization of this work, putting it upon an engineering basis, it is felt the cost might possibly be reduced, at the same time greatly improving the work.

There are no suitable texts in which metallurgy, metallography, strength of materials, hardness of materials, heat treatment, machinability, and so forth, are brought together. These are the fundamental things the processing laboratories must bring out. It is with the development of these laboratories in all their correct relations that the group in this division is concerned. They can be and shall be one of the best phases of our engineering education.

Interest in the sessions was shown, not only by the attendance, but also by the wide and lively participation in the discussion.

A luncheon and a dinner were held on Wednesday, June 20, at which the discussions were continued.

It was decided that this section should continue throughout the year 1934–35, and the clearing house idea given a trial. It was also decided that another name should be given the section. The task of selecting a suitable name was left to the Committee. An executive committee composed of Professor Barnes of the University of Iowa, Professor Gwiadowski of the Case School of Applied Science, and Professor Sweigert of the Georgia School of Technology, was elected to carry on plans for this next year.

R. L. SWEIGERT, *Secretary.*

PRE-COLLEGE GUIDANCE AND FRESHMEN ORIENTATION

The subjects discussed in this year's conference, June 19–21, were grouped under three main headings. The first session considered Pre-College Guidance, the second and third sessions took up the question of Orientation of Freshmen, and the final session suggested ways in which the regular work of the freshman curricula might assist in guidance programs. The opening session on Tuesday afternoon was a joint meeting with the Division of Drawing and the Junior College Session. Many interesting and

thought provoking papers were presented. Various speakers pointed out the danger of counselors and guidance programs doing for the student much that he should do for himself, thus permitting guidance to degenerate into coddling.

So many good ideas were given that it is difficult to more than present some of the thoughts which appealed to the writer of this report. The speakers and topics were, in order of presentation, as follows:

Ira M. Smith, Registrar, University of Michigan. "The High School Principal and His University Freshmen." This was a clear, detailed account of a successful method of coöperating with the high schools of Michigan. A sympathetic understanding of the problems of both high school principal and college administrator has been developed and a working program helpful to both has been established.

Clair V. Mann, "Aptitude Tests." This paper described a series of tests which have been devised and ways of using the test results. Many experiments have been made to obtain satisfactory measures of interest and aptitudes, thus enabling the college to better advise the undergraduate.

W. R. Dumble, Ohio State University, "Freshman Week." This paper was a description of a successful freshman week program and the "follow-up" work for the rest of the year.

L. O. Stewart, Iowa State College, "The Counselor System." This paper discussed the rôle of counseling in education and the basic principles which must be adhered to by any successful program. The danger of permitting counseling to drift into "spoon-feeding" was pointed out. The closing part of the paper gave an outline of the Iowa State College plan.

A. H. Edgerton, University of Wisconsin, "Present-Day Counseling Needs and Employment Demands." The long-range social value of proper guidance was pointed out. In reference to the present day questioning attitude toward higher education, he emphasized the necessity of the college making a quicker response to the social and technological changes in our civilization.

Justus Rising, Purdue University. This paper was a progress report on the program which he outlined in the Chicago meeting last year. Some of the experiments gave satisfactory results, others negative. In connection with one of the latter he says: "This result seems to indicate that it is a waste of time to prepare written instructions and expect a student to get enough out of it to pay for the effort."

A. S. Langsdorf, Washington University. A number of arresting comments were made in this talk. "Teaching and counseling of parents is often of more importance than the guidance of the

student. He may have the better idea of the work he should follow. Guidance counselors should be ready to direct the student out a side or back door of college as well as to a goal within. We have been too much concerned with numbers. We must return to the old fact, once better appreciated, that not all people are educable. We are doing more training than educating."

W. S. Evans, University of Maine, and A. D. Hinckley, of Columbia University, spoke on the subject of Personnel Departments. Professor Evans gave suggestions for establishing an effective personnel system in a small or medium-sized school. In such schools it is necessary to keep the machinery simple and reduce clerical work to a minimum. Professor Hinckley gave brief comments on various guidance systems which he had noted in his recent trip in which he visited some fifteen institutions in the midwest and far west.

Glen U. Cleeton, Carnegie Institute of Technology, and M. E. Troyer, Ohio State University, reported the clerical methods being used in their respective institutions to aid students whose grades, test scores, etc., indicated the need of remedial work. Both speakers emphasized difficulties in reading skill as prolific sources of scholastic troubles.

C. S. Coler, Westinghouse Electric and Manufacturing Company, emphasized the fact that education is a continuing process and educators cannot expect to completely form a man's life program in four or five years. Men should be kept ready for the unexpected and the individual must be able to adjust himself to new conditions frequently.

H. S. Rogers, Brooklyn Polytechnic Institute, summed up the objectives of counseling and the difficulties encountered in educational guidance. We should be wary of the philosophy that each man has some particular field of educational or vocational interest in which he may excell. While proper guidance may aid in developing latent capacities, it seems safe to say that it cannot compensate for lack of native ability.

The last group of papers discussed the orientation possibilities of various engineering courses. Frank Kerekes, Iowa State College, and H. M. McCully, Carnegie Institute of Technology, discussed various phases of engineering drawing. Philip Kissam, Princeton University, pointed out the values of surveying and R. W. Lindley, Purdue University, gave figures showing the correlation of shop grades and the term average of engineering students.

E. R. Wilcox, University of Washington, pointed out the need and success of engineering problems courses as measures of engineering aptitude. "The successful meeting of science course requirements is not always a reliable index of good engineering apti-

tude." "Numerous major professors and upper division students feel that the most helpful first year courses were the engineering problems courses because here they were taught procedures that were directly beneficial to them in all their other courses." The second half of this paper discussed the decided advantages of establishing a separate department for coördinating the first year or first two years of the engineering student.

F. C. DANA, *Chairman.*

TECHNICAL INSTITUTES

Two sessions were held, June 20, 21, on the subject of Industrial Economics as applied to Technical Institute Training. Walter B. Russell of Franklin Union presided at the Wednesday evening discussions. J. A. Randall of Rochester Mechanics Institute opened the discussion on "The Technical Institute's Responsibility for Educational Experimentation under Changing Industrial Conditions." The speaker showed that because of its form of organization and its flexibility of program the technical institute is admirably adapted to constructive experimental work in education. "What shall the Engineering College do with students who turn out vocationally-minded rather than professionally-minded? By suitable sifting at time of entrance, is it possible to avoid this situation?" was discussed by Harold N. Cummings of the Newark College of Engineering, William H. Timbie of the Massachusetts Institute of Technology and by H. H. Higbie of the University of Michigan. The latter, who was unable to be present, sent written remarks. All agreed that the problem was real. At least part of the trouble lies with the type of student admitted. Some felt that methods of admission might be improved, others that the student could well be more closely observed and counseled and one speaker favored the first year of college work designed particularly for the vocationally-minded with the strictly professional work beginning with the sophomore year. He even claimed that the vocational atmosphere for one year would prove advantageous to those who were later to follow up theory and research. It would give the college opportunity to counsel those who had proved practically-minded and to advise change to more suitable forms of training.

"The advantages and disadvantages that have been demonstrated by experience of conducting technical institute training in the same institution with degree-granting courses" was clearly set forth, in writing, by Arthur C. Jewett, Director of the College of Industries, Carnegie Institute of Technology. Director Jewett said that the technical institute type of training is being replaced by degree courses beginning the next school year. This serves to emphasize the fact that technical institute training cannot as a rule

thrive in an academic atmosphere. Someone remarked that the country is "degree-crazy."

In contrast with the foregoing, industries' attitude was shown in answer to the topic "What is industry's attitude regarding the employment of degree *vs.* non-degree men for supervisory positions in manufacturing and industry?" Carl S. Coler, of the Westinghouse Technical Night School, and Cyril M. Jansky, of the University of Wisconsin, were the speakers. Industry is open-minded and accepts degree and non-degree men in competition. Measurement is based on achievement of results and the race is open to all. The Westinghouse Night School offers aid to the ambitious workman, while coöperative graduate instruction is made available to college graduates.

At the Thursday morning conference Robert I. Rees of the American Telephone and Telegraph Company presided. As a background for the speakers, the chairman asked the following question: "How shall there be organized for technical institute students a program of training in industrial economics that may serve as a foundation and guide for sound thinking or experimentation in the field of the economic, social and human aspects of industrial engineering?"

Thomas N. Whitehead, of the Harvard Graduate School of Business, spoke on "Scientific Measurements of the Influence of Different Human Factors on the Rate of Production" and described in detail the tests made on a group of workers at the Chicago Plant of the Western Electric Company and extending over a five year period.* The next speaker, James Boyle, Professor of Agricultural Economics at Cornell, spoke on the Need of Sound Economic Guidance for Industry as it concerned the technical student.

"Experimentation in the Field of Measurement of Various Capacities of Different Individuals" was the subject of the third talk, by Harvey N. Davis, President of Stevens Institute. Dr. Davis gave an interesting description of the tests being conducted at Stevens Institute under the direction of Johnson O'Connor. Charles R. Mann, of Washington, spoke of the opportunities for engineering schools to work scientifically and critically with tests such as Dr. Davis had described. He presented a special plea that engineering schools assign certain members of their staff to deviations and tryouts of these tests—a form of investigation which owes its start to experiments made several years ago by Professor Thorndike. He said further that engineering schools are an ideal place for psychological studies.

W. B. RUSSELL, *Chairman.*

* The results of Professor Whitehead's study have been recently printed by the Harvard Graduate School of Business Administration.

EDUCATIONAL WASTE *

By F. H. SIBLEY

Dean, College of Engineering, University of Nevada

This title may indicate one of those intangible discussions of generalities, not always glittering, that find their way into the literature of science and engineering and which leaves the audience or a reader with nothing to get their teeth into—discussions that call to mind the lines of Omar Khayyam.

> "I when young did oft' frequent
> Doctor and Saint and heard great argument
> About it and about, yet evermore
> Come out by the same door wherein I went."

I may say in defense of this title that it was suggested by the report published in 1921 by a committee of the Federated Engineering Societies, headed by Herbert Hoover entitled "Waste in Industry." The report of the Committee on the Investigation of Engineering Education by William Wickenden and the study of the Land Grant Colleges by the United States Office of Education will convince any reader that wastes in education are no less real than in industry although they are less specific and probably more difficult to evaluate and remedy.

By waste is here meant effort that produces no increase in the sum total of culture, culture in turn meaning the building of mental power and good personality. I shall divide educational waste into two kinds, ponderable, those wastes that can be evaluated, and imponderable, or those which cannot.

Among ponderable wastes I would place a considerable part of our scientific and technical literature. A writer in the September issue of the JOURNAL of this society calls attention to the profound influence exercised by text books for example, on the minds of students as well as teachers. Nobody will dispute the fact that the literature of engineering has improved greatly in the last two decades nor can it be denied that there is room for much more improvement. The waste in this particular is not so much the monetary one caused by publishing and buying duplicate and non-essential texts as is the loss of time and culture on the

* Presented at second annual meeting of Pacific Southwest Section, Los Angeles, December 29, 1933.

part of students who are required to purchase and read books which produce more heat than light.

Somewhat to my surprise, corrected if wrong, a search of the list of standing committees of this and other national societies of which I am a member fails to reveal any committee on text books or on the publication of scientific and engineering literature although a joint committee exists for standardizing symbols and abbreviations. Such a committee could do much to uncover and promote the publication of worthy texts and it would seem as if the publishing houses would welcome in their own interests such co-operation.

Another of these ponderable wastes can be charged to bad methods of teaching in the class room and laboratory. Hammond, in the September number of the JOURNAL OF ENGINEERING EDUCATION makes the statement, apparently after careful study, "that there has been virtually no fundamental change in methods of teaching in the engineering colleges in forty years."

The objective of technical instruction is still in the main the storing of students' minds with facts instead of training them to think. The instructor having early had it impressed on his mind that he "cannot teach more than he himself knows," devotes his study to acquiring the details of his profession and passes it on to his classes, studying their lessons for them. He cringes at the thought of saying "I don't know," before a class and his pupils in turn regard him as an animated encyclopedia that saves them the bother of even using an index.

Have not Plato, Copernicus, Newton, taught the world more than they themselves knew? Is it not likely that Einstein and your fellow citizen Millikan know more than their teachers ever did? It is the inspiration not facts that count in teaching.

Laboratory instruction is often more misguided than that of the class room. Minutely detailed directions such as (*a*) "Insert wire in binding post, (*b*) fasten screw," are coupled with the twin evil of requiring long and elaborate reports based on erroneous or incomplete observations which teach the student nothing except dislike for his taskmaster.

Dean Holbrook of Pittsburgh in the September JOURNAL already referred to asks: "Why can't we admit that the attitude of a recent graduate towards his profession is of more importance than his knowledge of the details of his profession?" "Someday," he continues, engineering schools will be judged, not on the wealth of details in their several curricula but by the point of view they plant in the minds of the departing senior."

Closely allied with that of bad methods of teaching is the waste due to mistaken aims and confusion of aims. On page 144

of the report on the investigation of Engineering Education, Wickenden indicates five classes of technological students as follows:

1. Scientific specialists,
2. Professional Engineers,
3. Directors of technical Industries,
4. Technicians, such as foreman and supervisors,
5. Craftsmen and operators.

While our engineering schools are primarily concerned only with the second class we find in most colleges all these classes inextricably mixed and all receiving the same training. The mathematician and physicist taking the student in the earlier years of his training is apt to have in mind the scientific specialist while the engineering teacher too often visualizes the last three and seems to feel that his success is measured by the wealth of detail that he can pack into his pupils' minds.

A second outstanding leakage under this head is the bad equipment of most of our engineering laboratories; the word "most" is used advisedly. In the 160 or more engineering colleges in the United States there are thousands of dollars' worth of equipment that is almost or entirely useless for effective teaching. Equipment has been purchased according to the fancy or practical knowledge of the professor in charge and the laboratory exercises then made to fit the equipment instead of having a specific aim and purchasing the equipment to fit the principles to be demonstrated.

The Investigation of Engineering Education has pretty well established the fundamentals of an engineering education. It seems to me that this Society coöperating with the several professional engineering societies might work out and specify the minimum requirements for equipment and training in the standard engineering laboratories. To illustrate, I am just in the midst of moving and rearranging our mechanical laboratory at Nevada. In a semester course of 16 weeks we require from 8 to 12 laboratory experiments, what should those experiments be, having regard to the local conditions in order to give a mechanical engineer the most fundamental laboratory training?

Turning to what I have designated as imponderable wastes, consider the relationship between student and teacher. Perhaps due to a reaction from the mawkishness of the last generation, the present one seems to forego veneration for everybody and everything. Plato the master conversing with his pupil as they paced beneath the trees, Mark Hopkins on one end of a log and a student on the other, are ideals that have no counterpart in our modern educational scheme of things. In their place we too often have on one side the petty taskmaster requiring so many pages

of a report, to be finished on a certain date, under penalty of a low grade and on the other the sophisticated student who says of his instructor "raca." Important as are our laboratories, formal courses, and grading methods the most real as well as the most imponderable things that a teacher can pass on to his scholars is inspiration, spirit and morale.

The one bit of education that is outstanding during my whole college career was merely incidental to my courses. Perhaps some of you may remember John Howard Appleton, writer of chemistry text books in the latter part of the last century. He was my instructor in Freshman chemistry. At the end of one term I misread a schedule and cut one of his final term examinations. When too late I discovered my mistake. I went to his house and explained the situation, "Too bad," he said, "but I will try to fix it for you." Thereupon he put on his arctics, got his hat, coat and umbrella and tramped a mile to the campus through the cold and slush of a vile Rhode Island winter day to make arrangement with an assistant to give me that examination.

Whenever as teacher I have, with impatience, thought to pass lightly over the wants or perplexities of some student the remembrance of John Howard Appleton, the most prominent member of the faculty, tramping two miles through the slush to give a make-up to an insignificant freshman, has made me pause and consider. The effect has been to pass on and on to hundreds of students a spirit of patience and consideration. That man was an educator.

The late Henry Suzzalo in the bulletin of the American Association of University Professors says, "The teacher's human interest, sympathy and understanding are just as important a part of his equipment as his academic and technical training and probably more fundamental."

Of all wastes the greatest is that of educating the unfit. President Sproul is quoted in a recent publication as saying "that the most extravagant waste of higher education is the attempt to give everybody who thinks he ought to have it, or whose parents believe they ought to have it, a college education."

According to the report of the U. S. Office of Education there were 65,000 students of engineering in the 148 Land Grant Colleges in 1930. The average cost per student to the state is $610—a total of near 40 million dollars per year. The *American Engineer* is authority for the statement that twenty million dollars are wasted or misspent annually in attempting to educate engineering students who lack the proper qualifications. This is more than one half of the total amount spent by governments, both state and national, on the land grant colleges.

Unfortunately the money misspent does not constitute the greatest waste. The greatest loss is the human. The sense of disappointment and failure, the inferiority complex that may last through life of young people who have foregone several years of earning capacity to take a college course for which they are proved unfit, is the really serious aspect of the matter.

"This waste must be stopped," says at writer in the *San Francisco Chronicle*, "but how—who shall determine the personal question of who may attend college and be educated at public expense?" The Office of Education's survey of the Land Grant Colleges indicates that not over 28 per cent of the cost of education to the state is paid by the students themselves. There is, I believe, a very definite opinion growing up amongst educators that the cost of higher education should be borne by those who benefit directly from it, after buildings and equipment have been furnished by the state.

The problem then is how to put the other 72 per cent of financial burden on the students and at the same time leave the way open for even the most indigent of those who give promise of being a public asset to benefit by a higher education.

Evidently some method must be found, first, of increasing tuition for all but exceptional scholars and, second, getting rid of the fetish of the standard engineering colleges program and substituting for it programs of specialized functional training as indicated earlier in this paper.

Some of you may remember an article published in one of the popular magazines some years ago about an alumnus who, returning after many years to his Alma Mater, found the dispirited and poverty-stricken professors of his college days, well dressed and happy, riding from luxurious homes to classes in good automobiles, tumbledown buildings and badly equipped laboratories replaced by marble columned edifices and up to the minute equipment. The alumnus in amazement called on the businesslike young president who had succeeded the stoop-shouldered old scholar of his day and asked him how he did it.

"It's very simple," the president replied, in substance, "we have a sliding scale of fees based on the aims and scholarship of the matriculate. If Mr. Millions wants to send his son here for four years to get rid of him and keep him out of mischief we accept the responsibility and make him pay for it. We also try to give the boy what he wants, whether social prestige, to be an athletic hero or just a plain fraternity-house lounge lizard. When he graduates he gets a diploma with a plain statement of what he has accomplished. We have tuition fees as high as $50,000 a year with everybody satisfied, we can pay adequate salaries to our professors

and allow those who are real students to obtain an education free of all cost to themselves."

No doubt most of those who read the article got a laugh out or it and sighed over the possibility, but I wonder whether it did not contain the germ of a wise idea. We already remit the fees of our best students through scholarship awards and at least one college is requiring its students to pay the full cost of operation. Why not go the whole road, base all fees on scholarship records, let the poor and the mediocre bear the whole burden and the real scholar, of which there is perhaps one in twenty, pay nothing. Would not this solve the problem of educating the unfit and put the cost of higher education upon those who receive it without discouraging the diligent and the able?

Dr. Mann and others who have studied the matter profess to be very dubious about appropriations for higher education being restored to predepression levels. Unless our engineering colleges are to languish, some other means of support must be found. This Society has exercised an ever increasing influence on professional education; should it not coöperate with such organizations as the recently formed Engineers' Council for Professional Development to eliminate the waste of over half of the income of the engineering colleges and apply it to enducating only those whose training promises to be an asset to society.

EARLY SYSTEMATIC INDIVIDUAL INSTRUCTION IN LABORATORIES. EARLY RESEARCH

By PALMER C. RICKETTS

President, Rensselaer Polytechnic Institute

Few persons, even those most interested in the history of education in this country, are cognizant of the great part Rensselaer School, afterwards Rensselaer Polytechnic Institute, has taken in the development of scientific education. To break down the tradition of centuries in a system of education is no easy task. Established in 1824 at a time when there was little popular information regarding the principles of science, and not much more knowledge of this kind among the faculties of the colleges, any organization existing for the diffusion of scientific knowledge was regarded with little enthusiasm by most of those who had been educated under the classical aegis.

Stephen Van Rensselaer, able and altruistic, a man of wealth and position, was wise enough to discover the genius of Eaton and employ him to deliver a course of popular lectures on natural science; afterwards appointing him head of Rensselaer School. Amos Eaton, geologist, botanist, chemist, called the "Father of American Geology," was one of the great men of science of his time. He was the first to give systematic instruction in field work in any school and, before Liebig and Lord Kelvin, was the first to establish (in 1824) in this or any other country, laboratories for the systematic individual instruction of students in chemistry and in physics. He developed in the school the first engineering curriculum to be created in the country in 1835, and the school gave the first engineering degree, that of Civil Engineer.

Later when B. Franklin Greene, the then Director, reorganized the course in 1849–50, the civil engineering curriculum he inaugurated formed the basis of courses of that kind in almost every engineering school afterwards established in this country. I believe he formulated the curriculum of the first course in mechanical engineering. Forty years before the departments of architecture were formed in the universities of Pennsylvania, Harvard, and Columbia, he published, in his classic pamphlet, entitled "The True Idea of a Polytechnic Institute," a curriculum for an architectural course, which want of funds alone prevented him from establishing at that time.

A pupil of Eaton, he fully appreciated the value of laboratory work and research so carefully instilled in the minds of his pupils by Eaton. In enunciating his ideas on this subject he wrote that in Chemistry and in Physics each student was furnished with all needful facilities for making his own experimental demonstrations; this being essential to success in the "business of research." Thus these two men, before there was any other school of engineering in this country, recognized the value of research and, as far as they could, developed a love of it in their students.

Surely this school, for its primacy * in almost everything found to be of value in methods of instruction in the scientific schools of this country to-day, must justly be recognized as the pioneer in schools of Engineering and Technology; and, as far as the development of schedule is concerned, even of architecture.

* See numbers 29, 32, and 45 of Engineering and Science Series, published by Rensselear Polytechnic Institute; also article in Vol. 4, November, 1933, of *Physics Forum*.

A MECHANICAL TEMPERATURE ENTROPY DIAGRAM

A. M. HILL

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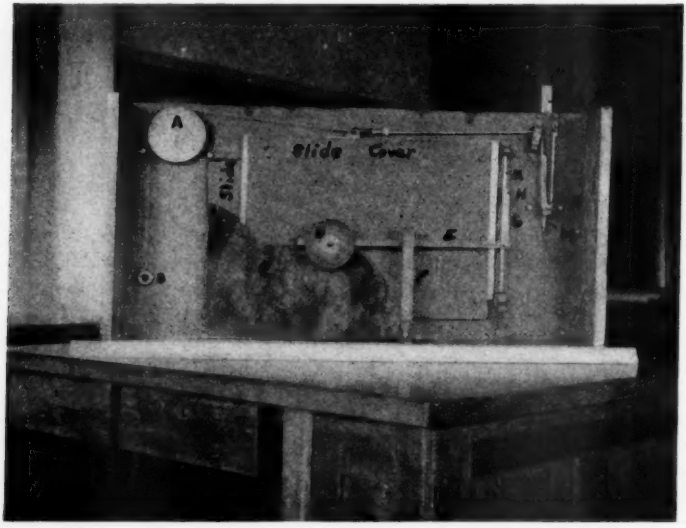
The device here illustrated has been used to impress engineering students with the sequence of events represented by a temperature-entropy diagram.

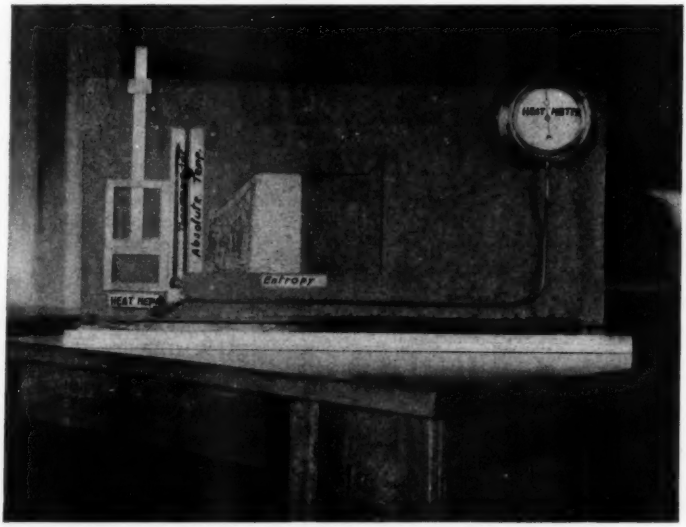
The model operates as follows: Heat flows through the "heat meter" block into the water contained in the cylinder. The cylinder is here represented in cross section. As "heat" is added, the diagram is uncovered, the sliding indicator on the "thermom-



eter" rises until the entire water line is exposed. In the meantime the hand on the "heat meter" is slowly revolving, the meter being calibrated in B.t.u. Up to this point the piston in the cylinder has not moved. As the vaporization line of the diagram is uncovered, the piston rises, indicating the formation of steam. The temperature indicator remains stationary, but the hand on the heat meter continues to revolve, indicating the heat of evaporation. When the

superheat portion is reached the temperature indicator again begins to rise. The thermometer is calibrated both in degrees F. and absolute units.

The other photograph shows the construction of the device as seen from the rear. The "slide" uncovers the diagram and actuates the sheet metal cam or outline *C*. This member *C* by means of the arm *E* and link *G* determines the motion of the thermometer indicator *H*. This indicator slides up and down upon the rod *K*, and projects through a vertical slot to the front of the board. A yoke at the left end of *E* straddles the sheet metal outline. *F* is a support for *E*.



At the top of the slide a piece of sheet metal is attached to which two cords are fastened. One cord wraps around a grooved drum which attached to the hand of the heat meter. Positive motion is given to this drum *A* by means of the counterweight *B*. The other cord passes over a pulley near the top of the board, then down over pulley *N*, then up, and is fastened near the top, as shown. The arrangement reduces the motion of the piston to one half that of the slide. The pulley *N* is fastened to the back of the piston rod; this connection slides up and down in the slot *M*. This slot is so placed that looking from the front of the model it is covered at all times by the piston rod.

The paper upon which the diagram is drawn is fastened to the front of the "slide cover" and may be seen projecting beyond it.

A yardstick placed in front of the model indicates its size. The copper tubing connecting heat block with the heat meter is for appearance only.

The materials used were as follows: Masonite for the main body, slide and slide cover; galvanized iron for *C;* brass rods and strips comprised the rest; the base and trim were of wood.

HONORS GROUP PLAN *

By R. H. FRAZIER

Assistant Professor of Electrical Engineering, Massachusetts Institute of Technology

This paper is not a committee report, but is a report on a project which has been carried on in the Department of Electrical Engineering at the Massachusetts Institute of Technology during the past nine years. However, the opinion is advanced in passing that projects of this sort are of such fundamental importance to the vitality of engineering education, and furthermore that they have acquired sufficient foothold in a few engineering schools, and have aroused sufficient general interest, that serious formal study by the Society, perhaps through the medium of a committee should be considered.

The idea of honors courses and associated comprehensive examinations has been coming very much to the front in American educational institutions during the past dozen years or thereabouts, especially in the colleges of liberal arts. The engineering schools have lagged behind in this development, to a considerable degree. The failure of the idea to take hold more generally, perhaps is due largely (1) to an inadequate somewhat non-descriptive terminology, (2) to an ill-founded prejudice against apparent "undemocratic" practices and foreign importations, and (3) to a long standing habit of treating young men as boys.

The phrase "reading for honors" is associated primarily with the English universities of Oxford and Cambridge. Oxford long frowned upon the sciences, and even now has no distinct courses in engineering. Cambridge, though long of high repute on account of the great scientists she has fostered, has only in recent years introduced courses in engineering, and these, in contrast to American practice place comparatively little emphasis on laboratory work. Dr. Wickenden, when director of the investigation of engineering education conducted by the Society, stated that "reading for honors" lends itself better to a library than to a laboratory discipline. Swarthmore, one of the leading American institutions in the introduction of honors courses, uses the phrase "reading for honors at Swarthmore," yet the plan extends to the engineering

* Presented at the 42d Annual Meeting, Cornell University, June 19–23 1934.

courses. Many of the American institutions offering "honors" mean merely that they award a distinctive designation to those who acquire high grades or do some extra work. There is even confusion with the "honor system" of unproctored examinations. Furthermore, the term "comprehensive" or "general" examination is used to cover a variety of styles of examination. The prejudice against apparent "undemocratic" practices is founded on a general overconfidence as to the variety of situations and the extent therein that the principle of equality is literally applicable. The prejudice against foreign importations rests on matters of detail rather than upon matters of principle. The habit of treating young men as boys is due partially to failure to recognize that young men learn to accept responsibility *by accepting responsibility,* and partially to the vanity of professors concerning the indispensability of their particular lectures and detailed assignments.

The Honors Group Plan, as developed under the guidance of Professor Jackson, has been described in more or less detail in the literature from time to time since its beginning in 1925. The plan will be merely outlined here, except for two more recent developments of the past year. The usage of terms will be evident from the description. The plan is associated with the practice of sectioning in accordance with mental speed, which carries recognition of the fact that all men are born unequal, not only to the foremost students, but to all electrical-engineering-course students. The only sense in which the plan shares foreign ideas is in the placing of intellectual responsibility and obligation squarely upon the shoulders of the students. In this sense a description of the plan really embodies the spirit which is becoming more and more characteristic of the entire educational process of the Department.

For about the past sixteen years, beginning with the second term of the sophomore year, when electrical-engineering-course students enter upon the study of subjects given by the Department, the teaching sections have been made up of small groups of students of relative mental homogeneity. This sectioning in accordance with mental speed (an adaptation to engineering education of Dean Seashore's idea) is however in no sense viewed purely as a separation of the able from the incompetent. Hence the term "ability" is not used. It is a sincere effort to allow for the fact that all men do not learn with equal ease or speed. Ordinarily there is a fast, an intermediate, and a slow section for each of the basic principles-of-electrical-engineering subjects studied by substantially all of the electrical-engineering-course students. Though the scope of subject matter is in general the same for all sections, the manner of instruction is adapted to the requirements of the particular sections. In the fast section the work is likely to be

somewhat more mathematical and the problems treated somewhat more comprehensive; more collateral reading is expected of the students, and more responsibility for independent accomplishment is placed upon them. In the slow section there is somewhat more drill and repetition. Students may be transferred from one section to another at any time, as proves to be appropriate.

The experience with this process has proved it to be very advantageous. It is adaptable in any engineering department having upwards of twenty-five or thirty students in each year and correspondingly adequate staff. In addition to the advantages resulting from the homogeneity of each section, it gains the advantages of close contact between students and staff claimed by small colleges, without the accompanying disadvantage of the small number of staff contacts available to the students.

For the past nine years a group of students has been carefully selected from those who make application near the end of the sophomore year, and has been given during the junior and senior years unusual freedom to carry out plans of study more fully on individual responsibility. This honors group may be viewed as an extension of the fast section, beginning with the junior year, though the privileges and responsibilities for honors-group students extend to substantially all subjects of the electrical-engineering curricula, not merely to those subjects taught within the Department. The provisions of the plan are designed to encourage the development of initiative, resourcefulness, and self-reliance in the students. Owing to economy of time made possible by waiving certain requirements relating to laboratory work, class attendance and examinations, the students are expected to gain a deeper and more unified understanding of the subjects in their field of study through laboratory work of a more investigative nature, through more intimate contact with staff members, through more extensive reading, and by attacking problems of a more comprehensive nature. The principal provisions of the plan are as follows:

1. A general counselor is provided from the Department staff for the junior honors group and one for the senior honors group. These counselors exercise general supervision over the students' work and are responsible for the proper functioning of the plan. They can be called upon by the students frequently for advice. Other members of staff are available also for conference in connection with the work of particular subjects.

2. The electrical-engineering-laboratory work consists not of a series of specific assignments, but of a general assignment each term relating to the principles and characteristics of the circuits and apparatus to be studied. The specific problems and methods of work are determined by each student under the advice of proper

members of staff. Each student keeps a continuous notebook containing an outline of his plan for the term, a record of his investigations and comments, and a summing up of his accomplishments. When such investigations prove to be sufficiently promising, they can be pursued further as thesis problems, beginning even in the junior year.

3. In most of the other subjects of instruction, a weekly seminar meeting is conducted for honors-group students in place of the usual classes. One member of the staff is in charge of each seminar, but other staff members are invited to participate. The meetings are conducted on a discussion basis rather than on a lecture or recitation basis. Questions and problems of a more comprehensive nature than is customary in the usual class-room procedure are attacked; such problems are suggested for students to work on independently and the results of these and other investigations or reading are reported and discussed. A particular effort is made to illustrate the interrelationships of and the analogies between various subjects of the curriculum. The usual quizzes are omitted. In connection with each seminar a syllabus of subject matter, a list of reading references, and a set of comprehensive problems are given to each student as an aid in planning and testing his mode of study.

4. Instead of the usual term examinations there are two comprehensive examinations, one at the end of the junior year, and one at the end of the senior year. Each examination has a written part, extending over a two-weeks' period, and the senior-year examination includes a day of oral examination. The written part of each examination consists of two sections: the shorter section deals more particularly with brief questions relating to particular subjects and the producing of accurate results under pressure of limited time; the major section deals with careful analysis after adequate reflection, of longer project-type problems, each in itself more or less comprehensive, involving the interrelationships of material of several subjects, and being of a nature that makes a demand upon originality, resourcefulness and judgment. The oral part of the senior-year examination consists of individual conferences between students and examiners, and a joint meeting of students and examiners at which brief oral presentations of problem solutions or results of investigations are given, and there is general appraisal and discussion of the value of the examination procedure. The examinations are set by a committee of staff members with whom are associated several outside examiners invited from industry and other engineering schools.

Item 2, concerning the investigative nature of the laboratory work, has been one of the most successful features of the plan since

the beginning. Item 3, concerning the seminars, and the part of item 4, concerning the junior-year comprehensive examination, are largely developments of the past year. Prior to that time, the honors-group students were given the opportunity of attending the usual class exercises or not, as they individually pleased, and were required to take the usual term examinations and quizzes until the last term of the senior year, near the end of which they were given a comprehensive examination. The results of these senior-year comprehensive examinations as compared with the results of the usual term examinations while not too discouraging, added considerable evidence to the views of practicing engineers that engineering-school graduates ordinarily are well-equipped to handle a segregated part of a typical engineering problem, but that they are too frequently unable to meet new situations adequately. The experience with the seminar process during the past year, as an aid in correcting this situation, though pointing to the need for further development and study, is encouraging. The results of the senior-year comprehensive examination this spring were excellent, being in fact the best results obtained thus far. The results of the junior-year comprehensive examination were not so good, but were nevertheless better than the results of the senior-year examinations the first few years they were tried. Hence the situation is anything but discouraging, and will be developed further next year along the lines outlined.

COLLEGE NOTES

University of Alabama.—Dean George J. Davis, Jr., who was on leave of absence during the last session serving as state engineer P. W. A. for Alabama, has resigned his position with the P. W. A. and has returned to his duties at the University.

Professor John S. Leister has been appointed assistant professor of civil engineering.

The Public Works Administration has allotted $200,000 for the construction, on the campus of the University of Alabama, of a laboratory building for the Southern Experiment Station of the U. S. Bureau of Mines, which has been located at the University since 1920.

Registration to date shows an increase in the enrollment of the freshman class over the enrollment at the same time last year of fifteen per cent.

The attendance of the University is the greatest in its history.

The School of Engineering of the **University of Delaware** is very happy to announce the appointment of Thomas Douglas Mylrea, C.E., to the position of Associate Professor of Civil Engineering and Acting Head of the Department.

Professor Mylrea comes from Carnegie Institute of Technology where he has been Professor of Building Construction for the past eight years. Before then he was a member of the teaching force of the University of Illinois in both the graduate and undergraduate departments. Professor Mylrea is a member of Committee 501 of the American Concrete Institute and has contributed several valuable papers to the Civil Engineering profession.

University of Idaho.—Mr. Clarence H. Schowalter, B.S. (M.E.), University of Wisconsin, 1926, and aeronautical engineer, New York University, 1929, has been appointed to the position of instructor in Mechanical Engineering at the University of Idaho. Mr. Schowalter has had experience with the laboratories of the National Advisory Committee for Aeronautics, with the Lycoming Manufacturing Co., and with the Lawrence Engineering and Research Corporation.

Mr. Arthur Jerome Davidson, B.S. (C.E.), 1933, University of Idaho, and M.S. (C.E.), University of Idaho, 1934, returns to the University this fall to fill a newly created position of instructor in Civil Engineering. Mr. Davidson has had work with the U. S. Coast and Geodetic Survey and with the U. S. Reclamation Bureau.

University of Illinois.—Several changes in administrative positions in the College of Engineering were made effective on July 1 and September 1 for the 1934–1935 school year. On July 1, Dean A. C. Willard, who had served as Acting Dean of the College of Engineering and as Acting Director of the Engineering Experiment Station during the past year, and who had served as Professor of Heating and Ventilation since 1917 and Head of the Department of Mechanical Engineering since 1920, became President of the University when Acting President A. H. Daniels became Acting President Emeritus. On September 1, former Dean Milo S. Ketchum, who had served as Dean of the College of Engineering and Director of the Engineering Experimnet Station from 1922 to 1933, and who had resigned on account of continued ill health, became Dean of the College of Engineering and Director of the Engineering Experiment Station Emeritus.

On July 1, Professor M. L. Enger, Professor of Mechanics and Hydraulics and Head of the Department of Theoretical and Applied Mechanics, was made Dean of the College of Engineering and Director of the Engineering Experiment Station, and Professor F. B. Seely, Professor of Theoretical and Applied Mechanics, was made Head of the Department in his stead. At the same time, Professor O. A. Leutwiler, Professor of Mechanical Engineering Design, became Head of the Department of Mechanical Engineering in place of President Willard. On September 1, Professor H. H. Jordan, who for a number of years has served in the dual capacity as Assistant Dean of the College of Engineering, and Professor of General Engineering Drawing and Head of the Department, became Associate Dean of the College, while still retaining the same relationships with the Department of General Engineering Drawing.

On September 1 also several changes became effective among members of the staff in full-time teaching positions, notably the following in the rank of full Professors: E. H. Waldo, Associate Professor of Electrical Engineering, became Associate Professor Emeritus; J. J. Doland, Associate Professor of Civil Engineering became Professor of Civil Engineering; A. R. Knight, Associate Professor of Electrical Engineering, became Professor of Electrical Engineering; T. C. Shedd, Associate Professor of Structural Engineering became Professor of Structural Engineering; and W. J. Putnam, Associate Professor of Theoretical and Applied Mechanics, became Professor of Theoretical and Applied Mechanics.

University of Maine.—Dr. Arthur A. Hauck succeeds Dr. Harold S. Boardman as President of the University of Maine. Dr. Boardman, who is a past president of the Society for the Promo-

tion of Engineering Education, resigned because of ill health. Dr. Hauck was graduated from Reed College, Portland, Oregon, in 1915 and received his Ph.D. from Teachers College, Columbia, in 1932. He has had much experience in the field of education having been President of Punahou School at Honolulu, Assistant to the President of Vassar College and Dean of Lafayette College.

Last spring there was created by action of the Board of Trustees, a Department of Pulp and Paper Technology with Professor Paul D. Bray (U. of M., B.S. in Chemistry, '14; Ch.E., '18) as its head. This work has formerly been included in the Chemical Engineering curriculum. Professor Bray has been a chemist with the Katahdin Pulp and Paper Company, Chief Chemist of the Eastern Manufacturing Company, Assistant Superintendent of the Eastern Manufacturing Company and, until his appointment as Professor of Pulp and Paper Technology, Associate Professor of Chemistry at the University. He will be assisted by Mr. J. G. L. Caulfield (U. of M., B.S. in Chemical Engineering, '24; M.S., '26) as Instructor in Pulp and Paper Technology. Mr. Caulfield was formerly an Instructor in the Department of Chemistry.

Other changes in the staff of the College of Technology are as follows:

Lyle C. Jenness (B.S. in Chemical Engineering, N. H., '22; M.S. in Mathematics, U. of M., '25), formerly Assistant Professor of Chemistry, has recently been appointed Associate Professor of Chemistry.

Weston S. Evans (B.S. in Civil Engineering, U. of M., '18; M.S., '23), formerly Associate Professor of Civil Engineering, has been advanced to full Professor and Head of the Department of Civil Engineering.

Embert H. Sprague (B.S., Dartmouth, 1900), who formerly held the title of Professor of Civil Engineering, has been appointed Professor of Sanitary Engineering.

Harry D. Watson, Associate Professor of Mechanical Engineering, has been placed in charge of personnel work in the College of Technology with Neil M. Calderwood (B.S., Maine, '32), a graduate student, as part time assistant.

H. Elmer Hall (B.S., Washington State College, '28; M.S., Pittsburgh, 1930) recently tendered his resignation as Instructor of Mechanical Engineering at the University of Maine to accept a similar position at the Massachusetts Institute of Technology.

Cecil C. Tyrrell (Purdue, B.S. in Mechanical Engineering, '31; M.S., '32), has been appointed Instructor of Mechanical Engineering. Mr. Tyrrell has had considerable industrial experience with the General Electric Company.

The courses in Architectural Drawing, which last year were

offered by the Civil Engineering Department, have been transferred to the Department of Engineering Drafting and will be taught by Miss Gertrude Ebbeson (S.B. in Architecture, M. I. T.) who holds the title of Special Lecturer in Engineering Drafting. Last year Miss Ebbeson was Special Lecturer in Civil Engineering.

During the past four months, extensive changes have been made in the buildings of the College of Technology. Wingate Hall, Fernald Hall and Lord Hall have been remodeled into thoroughly up to date buildings. A splendid new building has also been built to house the shops of the Mechanical Engineering Department. Wingate Hall will contain the Departments of Civil Engineering and Engineering Drafting, the Dean's Office, and the Maine Technology Experiment Station. Fernald Hall will house the Department of Mechanics and will also have a large classroom and office for Geology. Lord Hall has been enlarged and will house the Department of Electrical Engineering and some of the offices and classrooms of the Department of Mechanical Engineering. A large new electrical power laboratory, a number of sound proof communication laboratories, a broadcasting room, computation rooms and new offices have been added in this building. The new shop building is a one story E-shaped building, one wing of which houses the Machine Shop, another the Wood Working and Pattern Shop and the third wing, the Forge Shop and Foundry. The building is of the lastest shop construction, well lighted and ventilated and additions can easily be made without destroying the arrangements of departments.

The Maine Technology Experiment Station has issued recently an important bulletin, "Survey of Road Materials and Glacial Geology of Maine," by H. Walter Leavitt, Associate Professor of Civil Engineering, University of Maine, and Edward H. Perkins, Professor of Geology at Colby College. Volume I of this bulletin is in two parts, the second part consisting of maps showing the location of rock, sand and gravel deposits in Maine.

Federal relief work, under the direction of Mr. L. D. Stephenson, State Representative of the United States Coast and Geodetic Survey and Instructor in the Department of Civil Engineering, will be continued this year. Last year fifty-six men were employed on a project in which two hundred and fifty square miles of the State were surveyed and the principle elevations determined. This year another two hundred and fifty square miles will be surveyed and approximately fifty men will be employed.

Massachusetts Institute of Technology.—The Institute now offers a new five-year course designed to meet the demand for engineers with a thorough understanding of the social and economic

implications of their profession. This course will include essentially the same professional studies as are offered at present in any one of the departments of engineering or science, but will also include an increasing program of more advanced studies in the fields of economics and the social sciences running through the last three years of the five-year course. On satisfactory completion of the fifth year there will be awarded the degree of bachelor of science in the professional field, such as civil, electrical or mechanical engineering, or chemistry, physics or biology, and also the degree of master of science in economics and engineering.

Ten new members of the faculty whose achievements have distinguished them in various fields of industry and education have assumed their duties at the Institute.

From the University of Wisconsin comes Dr. Warren J. Mead, eminent teacher and widely known consultant, to head the department of geology. Walter G. Whitman, former associate director of research for the Standard Oil Company of Indiana, and a graduate of Technology in 1917, will take charge of the department of chemical engineering.

Roy W. Carlson, known for his research in structural materials for large dams, joins the staff of the civil engineering department as assistant professor. In addition to his teaching he will carry on research in cement and concrete. Dr. Robley D. Evans becomes assistant professor in the physics department. Both come to the Institute from the University of California. Professor Edwin S. Burdell, '20, of Ohio State University, becomes associate professor of sociology in the department of economics and social sciences.

Dr. Joseph H. Keenan, '22, former chairman of the mechanical engineering department at Stevens Institute of Technology, has been appointed associate professor of mechanical engineering. From the same institution comes Professor John B. Fife, who under the Institute's new plan of faculty exchanges, becomes exchange professor in the department of English and history. Professor William C. Greene of the Institute's staff will in turn spend the year at Stevens. Under the same plan, Professor John F. Byrne of Ohio State University joins the staff of the department of electrical engineering, exchanging places with Professor Harold L. Hazen.

Two noted engineers from industrial fields are Dr. Francis Bitter, formerly with Westinghouse Electric and Manufacturing Company, and Alfred V. deForest, '12, consulting engineer and former member of the staff of the American Chain Company.

University of Michigan.—Starting with this Fall, the College of Engineering will offer two new combined courses, one with the

School of Business Administration and one with the School of Forestry. In both cases the students will take the first three years in the College of Engineering, and a dual enrollment with the other College for the fourth year. Students will not be recommended for the combined course unless they have obtained a grade of 2.5 instead of the average of 2.0 ordinarily required in the College of Engineering. Upon the satisfactory completion of the fourth year's work, they will be granted the degree of Bachelor of Science in Engineering without a specific designation as in the regular Engineering courses.

Northeastern University.—Two new graduate assistants have been appointed in the Day Division. John A. Metcalf, a graduate of the School of Engineering in the Civil Engineering Department in 1934, has been appointed a graduate assistant in the Northeastern Student Union. Edward VanDusen, '34 Industrial Engineering, has been appointed a graduate assistant in the Department of Physics. Mr. Metcalf will study at Harvard in the field of Geology and Mr. VanDusen at Boston University in the field of Education.

The coöperative employment is slowly but definitely increasing. Notwithstanding the fact that 28 per cent of the senior class who graduated in June, 1934, were retained by their coöperating employers, there is an increase in the number of coöperative students employed this fall. A new division of the Coöperative Work Department has been established to administer the Federal Student Relief Program at Northeastern. Mr. Verner O. Nelson, formerly coördinator for electrical engineering students, is in charge of this new branch of the Department. Mr. Rudolph O. M. Oberg replaces Mr. Nelson as coördinator for electrical engineering students.

Purdue University.—Professor S. C. Hollister, who had charge of instruction in structural engineering at Purdue University for the past four years, has accepted the directorship of the School of Civil Engineering at Cornell University.

Charles A. Ellis, consulting structural engineer, formerly in charge of structural engineering at the University of Illinois, and the designer of some of the most important bridges in this country and Canada, was appointed to the professorship of structural engineering vacated by the resignation of Professor Hollister.

Professor H. C. Peffer, for over twenty years head of the School of Chemical Engineering, died very suddenly on Tuesday, July 17th.

C. L. Lovell, who holds the Ph.D. from the State University of Iowa, was appointed assistant professor of Chemical Engineering.

C. W. Caldwell, for a number of years a member of the staff of

the State University of South Dakota, was appointed instructor in Electrical Engineering.

L. I. Aretz, an aviator of wide experience, was appointed assistant in aviation.

J. A. Bolt, a recent graduate of Michigan State College, was appointed half time assistant in Mechanical Engineering.

Charles R. Lillie and C. V. Allen and L. E. Endsley, Jr., recent graduates of Purdue University, have been appointed half time assistants in Chemical, Civil and Mechanical Engineering respectively.

W. N. Pritchard, a consulting chemical engineer of considerable experience, was appointed assistant in the Engineering Experiment Station.

Rensselaer Polytechnic Institute.—Since Commencement a number of important promotions have been made. Paul E. Hemke becomes professor and head of the Department of Aeronautical Engineering. Dr. Hemke, who studied at the University of Chicago, the Johns Hopkins University, and Cambridge University, has taught at the Georgia School of Technology, the Northeastern University, the United States Naval Academy, and the Case School of Applied Science, where he has had charge of the courses in aeronautics. For two and a half years he was associate analyst at the Langley Memorial Aeronautical Laboratory. He has contributed notably to the literature of his field and has served as consultant for a number of corporations. Although he will not assume his duties as head of the Department until September, 1935, he will be responsible for the design and installation of the apparatus for the new laboratory, now in course of construction.

In the Department of Electrical Engineering and Physics George R. Town, who has experience in industry and teaching, has been appointed instructor. Mr. Warren C. Stoker, who received his master's degree last year, has also been added to the staff.

Two appointments have been made in the Department of Chemical Engineering and Chemistry. Donald M. Calkins becomes instructor in chemical engineering. Walter H. Bauer, a graduate of the Oregon State College and of the University of Wisconsin, who has been teaching at the latter institution, becomes instructor in chemistry.

A number of the most important changes have occurred in the Department of Mathematics and Astronomy. After fifty years of devoted and distinguished service, Dr. Charles W. Crockett retires as head of the Department with the title of professor emeritus. Edwin B. Allen, formerly assistant professor, returns from Harvard University to succeed him. James McGiffert, associate pro-

fessor, is also promoted to a full professorship. Dennis B. Ames, Byron Cosby, II, and Ralph E. Huston are new appointees. Dr. Ames is a graduate of Yale University, where he was fellow and instructor. Dr. Cosby was graduated from the University of Missouri and the University of Chicago, where he held an instructorship. Dr. Huston, graduated from the University of Chicago and from Oxford University, has also studied in Germany and France. He has taught at several institutions, including the University of Chicago.

A building is now being erected on the campus of Rensselaer Polytechnic Institute to contain laboratories for the courses in aeronautical, metallurgical and chemical engineering. The building will be 184 feet long by 60 feet wide and five stories in height with a sub-basement. The lower story is a basement with full light on the back and windows six feet high on the front. The sub-basement is for a wind tunnel. Part of the basement will be used for an aeronautical engine testing laboratory and part for the machines of the chemical engineering department. There is an excellent chemical engineering laboratory in the Walker Chemical Laboratory but this new laboratory will provide room for more heavy machines and apparatus. The first floor will contain a large rigging room with drawing room and offices for the aeronautical course and also a chemical laboratory with offices. A lecture room, research rooms, and offices will be found on the second floor. The two upper floors will be devoted for the most part to metallurgical laboratories. There is an unusually excellent non-ferrous electrometallurgical laboratory in the Sage laboratory. This will be moved to the laboratory and much new ferrous metallurgical apparatus will be installed.

The building will be constructed of Harvard brick with Indiana limestone trimmings. The steel frame carrying the concrete floors will have all its joints welded. This will be, I believe, the first college building to have its joints welded. The roof will be of copper; the bulding fireproof throughout. It will be finished in the early months of 1935.

Syracuse University.—Professor Earl F. Church, who was appointed last June by Secretary of State Cordell Hull, as one of the two delegates from the United States to the fifth annual Congress of the International Federation of Surveyors, attended the sessions in London, England, from July 18 to 24.

Following the Conference, Professor Church spent several weeks in France, Germany, Italy and Switzerland inspecting the work which is being done in aerial mapping and surveying.

Professor Church is Associate Professor of Photogrammetry in the College of Applied Science at Syracuse University.

Texas Technological College.—During the past year a number of changes have been made in the faculty personnel. At the beginning of the year Mr. O. V. Adams, who had been Acting Dean of Engineering since the resignation of Dean William J. Miller on January 1, 1932, became Dean of Engineering.

Professor Carl Lars Svensen, who had been Head of the Department of Engineering Drawing since 1926 and who had been Acting Registrar since June 1, 1933, resigned at the beginning of the year. Professor Svensen's place was not filled until February 1, 1934, when Mr. Oscar A. St. Clair of New Rochelle, New York, was selected as Head of this Department. Professor St. Clair graduated from Armour Institute of Technology in 1905 with the degree of Bachelor of Science in Electrical Engineering. Professor St. Clair was formerly Chief Engineer of the Beaver Products Company and of the Atlantic Gypsum Company. It is planned to broaden the scope of work in this Department and to offer degrees in Industrial Engineering and Industrial Education.

The scope of the work in the Department of Architecture and Allied Arts, which formerly consisted of Architectural Engineering, has been broadened to include work in Architecture and Commercial Art.

In Mechanical Engineering a new curriculum has been set up leading to the degree of Bachelor of Science in Mechanical Engineering, Administrative Option. New equipment has been purchased enabling the scope of shop work to be considerably enlarged.

The work in Chemical Engineering has been transferred from the Department of Mechanical Engineering to the Department of Chemistry and Chemical Engineering, and the degree of Bachelor of Science in Chemical Engineering is now offered. Dr. Valerie Schneider was appointed February 1, 1934, as Associate Professor of Chemical Engineering. Dr. Schneider holds the B.S. and M.S. degrees from the University of Texas and the degree of D.Sc. from Massachusetts Institute of Technology.

The Department of Textile Engineering now offers three options in the degree of Bachelor of Science in Textiles, namely, Chemistry, Engineering, and Fabric Design.

Roger Clapp, B.S. in M.E., Texas Technological College, 1933, has been appointed Instructor in Mechanical Engineering.

The University of Vermont.—Professor E. R. McKee, of Iowa State College, has been appointed Head of the Department of Electrical Engineering in the College of Engineering of the University of Vermont.

Professor McKee succeeds Professor L. P. Dickinson, whose

death occurred in June of this year, and who had held the position as Head of the Department of Electrical Engineering since 1921.

Virginia Polytechnic Institute.—F. J. Sette, Associate Professor of Sanitary Engineering, has returned to duty after a year's leave of absence during which time he served as engineering examiner of the Public Works Administration of Virginia.

Stephen C. Andrews has been appointed Instructor in Industrial Engineering. Mr. Andrews graduated from V. P. I. in 1929, and has had several years of experience in the time and rate-setting department of the Erie Works of the General Electric Company.

A number of physical plant improvements and additions are being made under a P. W. A. allottment of $1,066,000. Among the major items are a teaching and administration building, auditorium, men's dormitory, faculty apartment house, utilities building, and extensions to the water and sewer systems.

SECTIONS AND BRANCHES

At a meeting of the **Georgia School of Technology Branch,** October 2, 1934, Professor F. C. Snow, Head of the Civil Engineering Department was elected Chairman for the year 1934–35 and A. D. Holland was re-elected Secretary.

We are looking forward to a great annual meeting here at Tech next June and want to assure you of our coöperation to that end.

Newark College of Engineering.—The local chapter of the Society for the Promotion of Engineering Education announces through Professor Frank N. Entwisle that a membership drive will be instituted at the October meeting of the chapter. The objectives for the present year provide for the enrolling of one hundred per cent of the faculty in the chapter. Always a very active group, the local unit intends to make this year a very important one in the chapter's progress.

Monthly meetings will be held throughout the year, and a field day and picnic will be arranged for late October. It is planned to engage speakers to address the members on topics of national interest at subsequent meetings. Last year this plan was tried with considerable success, and at the October meeting the committee to arrange for speakers will be named by Professor Entwisle, who heads the local unit.

Twice during the year the regular monthly meetings will be preceded by a dinner, and after the regular order of business is completed, an open forum will be held.

Professor Paul Schweizer is secretary of the chapter.

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

Convention Echoes: Quite apart from the fascination and interest of examining the exhibits of text books, old and modern, drawing instruments, and engineering drawings, it should be known that the committees which assembled this valuable exhibit at the Cornell Convention have added much to the historical records. The Engineering Drawing Division should have the enthusiastic support of the S. P. E. E. in their efforts to find ways and means not only of using this material as the nucleus of a permanent collection, but also in finding appropriate and accessible exhibit and storage space for the care and preservation of this valuable material.

From an historical point of view the exhibit of old books has added to the record the significant fact that 270 years before Monge wrote the first treatise on descriptive geometry, Albrecht Durer published drawings made by third quadrant projection, and showed in other ways that he clearly understood the principles of projection as early as 1525.

The collection of old drawings was a striking graphical record of progress in the development of modern drafting practice. The very nature of these old drawings further emphasizes the need for careful preservation, and the fact that so much interesting material was uncovered—and uncovered is exactly the word to use—indicates that a further search would disclose additional valuable records.

The collection of ancient and modern drawing equipment was of great educational value. Fortunately private collectors have preserved and collected the greater part of this historic record but the lack of interest in this direction on the part of engineers and engineering educators should be speedily corrected.

The excellent work already done by the Engineering Drawing Division should be considered but a first rate beginning.

BOOK REVIEW

Analytical Geometry. V. C. Poor. John Wiley & Sons, New York, 1934.

One of the best features of this book is the excellent arrangement of material. I am in accord with the author's plan of the early introduction of polar coördinates. He then develops polar coördinates simultaneously with that of rectangular coördinates in separate articles which come at the ends of several of the succeeding chapters. This mode of procedure enables the instructor either to follow the book or to omit the articles on polar coördinates and take them up at the end of the course. The author has obtained maximum flexibility by introducing in separate chapters the theory of diameters, poles, and polars, and the theory of higher plane curves and curve fitting.

This book contains many lists of well chosen problems. The author has succeeded in his attempt to select problems that involve some general principle in their solution.

On the whole, the book is well written, the statements are clear and concise. The introductory paragraphs at the beginning of each chapter enable the student to see clearly the plan of procedure and the unity to the book.

John C. Knipp